

**PONDICHERRY UNIVERSITY**

**PUDUCHERRY – 605 014**

## **REGULATIONS AND CURRICULUM**

**for**

### **B.Sc. (Hons.) AGRICULTURE DEGREE PROGRAMME**

(Effective from 2019-20 batch onwards - As per 6<sup>th</sup> UG-BoS-2022)



### **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 onwards - As per 6<sup>th</sup> UG-BoS-2022)**

**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

- The weightage of marks shall be in the ratio of 50:50 respectively for external and internal examination.
- 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
<b>Internal</b>			
Mid-semester Examination	30	40	40
Practical Examination	15	--	50
Assignment/submission of specimens	5	10	10
<b>External</b>			
Final Theory Examination	50	50	--
<b>TOTAL</b>	<b>100</b>	<b>100</b>	<b>100</b>

## 7.6 Mid Semester Examination (Internal):

- Writing the mid-semester examination is a pre-requisite for writing the final theory and final practical examinations. Student failing to write mid-semester examination, will not be permitted to attend the classes further in the course concerned and the student will be awarded 'E' grade.
- The duration of mid-semester examinations will be one hour for courses with theory and practical (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).
- The Dean with the help of the concerned year coordinator shall prepare and announce the schedule of mid-semester examinations.
- The mid-semester examinations shall be conducted from the 56<sup>th</sup> working day of the semester.
- The mid-semester examination shall be conducted and evaluated internally by the concerned course teacher(s).
- 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.
- The marks for assignment shall be included in mid semester mark for the courses with only theory.

## 7.7 Missing Mid-semester Examination:

- 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.
- Students deputed for official programmes of the College/University are exempted from paying the fee for missing test.
- Such missing examinations should be completed outside regular class hours within 15 working days after the respective examinations.
- 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
	<b>TOTAL</b>				<b>30</b>

**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
	<b>TOTAL</b>				<b>40</b>

\* 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:

<b>External Theory Examination (50 Marks &amp; 2.5 hours duration)</b>					
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
	<b>TOTAL</b>				<b>50</b>

\* 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
<b>Total</b>	<b>15.0</b>
<b>Assignment</b>	<b>5.0</b>
<b>Grand Total</b>	<b>20.0</b>

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

- 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.
- 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 (1 ½ hrs.)	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 – RAE 401 Rural Agricultural Work Experience and Agro-Industrial (0+20) – furnished along with VII Semester Syllabus.

b) B.Sc. (Hons.) Horticulture – RHE 401 Rural Horticultural Work Experience Programme – Placement in Villages (0+10) - furnished along with VII Semester Syllabus.

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

**7.17.3. Evaluation pattern for Experiential Learning programme (ELP XXX)**

S.No.	Parameters	Max. Marks
1.	Project Planning and Writing	10
2.	Presentation (pertaining to the product preparation, exhibits, cleanliness)	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
	<b>Total</b>	<b>100</b>

**7.17.4. PED\* (Non-Gradual 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:**

- 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.
- 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.

- Revaluation is not allowed for passed courses.
- Revaluation can be demanded only if a candidate has failed in not more than two courses in that session.
- The prescribed revaluation fee per course has to be paid by the student.
- The application for revaluation must be sent to the Controller of Examinations through the Head of the Institution.
- The application for revaluation should be made within 15 days from the date of declaration of results / publication of marks/grade.
- 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.
- 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 the residential requirement. No student shall be allowed to take up the ELP with 'E' grade in any course from I to VI Semester.
- (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 Notwithstanding anything contained in the rules and regulations, the Board of Studies or Academic Council shall make changes whenever necessary.

**GUIDELINES FOR SETTING THE QUESTION PAPER  
FOR EXTERNAL THEORY EXAMINATION  
(FOR COURSES INVOLVING THEORY AND PRACTICAL/ ONLY THEORY)**

1. Please prepare the **question papers 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:** 50**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)

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## 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 batch onwards - As per 6<sup>th</sup> UG-BoS-2022)**

**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 normal 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	- 1 <sup>st</sup> Day)
Last date for Registration <b>without fine</b>	:	06.08.2019	(Tuesday	- 2 <sup>nd</sup> Day)
	:	07.08.2019	(Wednesday	- 3 <sup>rd</sup> Day)
	:	08.08.2019	(Thursday	- 4 <sup>th</sup> Day)
	:	09.08.2019	(Friday	- 5 <sup>th</sup> Day)
	:	10.08.2019	(Saturday	- 6 <sup>th</sup> Day)
	:	11.08.2019	(Sunday	- Holiday)
Last date for Registration <b>with fine</b>	:	12.08.2019	(Monday	- 7 <sup>th</sup> 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.) AGRICULTURE DEGREE PROGRAMME

## DEPARTMENT WISE DISTRIBUTION OF COURSES

### ABSTRACT

Sl.No.	Department / Discipline	No. of courses	Credit hours	Total Credits
<b>Agricultural Economics &amp; Extension</b>				
1.	Agricultural Economics	5	8+3	11
2.	Agricultural Extension	4	6+3	9
3.	Computer Science	1	1+1	2
4.	Statistics	1	1+1	2
5.	English	1	0+1	1
<b>Agricultural Entomology</b>				
6.	Agricultural Entomology	4	6+4	10
<b>Agronomy</b>				
7.	Agronomy	11	12+10	22
8.	Agricultural Engineering	4	4+4	8
9.	Animal Husbandry	1	2+1	3
<b>Horticulture</b>				
10.	Horticulture	5	5+5	10
11.	Food Science	1	2+0	2
12.	Forestry	1	1+1	2
<b>Plant Breeding and Genetics</b>				
13.	Genetics and Plant Breeding	4	8+4	12
14.	Seed Science and Technology	1	2+1	3
15.	Crop Physiology	1	2+1	3
<b>Plant Pathology and Agricultural Microbiology</b>				
16.	Plant Pathology	4	7+4	11
17.	Agricultural Microbiology	1	2+1	3
18.	Nematology	1	1+1	2
<b>Soil Science &amp; Agrl. Chemistry</b>				
19.	Soil Science & Agrl. Chemistry	3	5+3	8
20.	Biochemistry	1	1+1	2
21.	Environmental Science	1	2+1	3
22.	<b>Elective Courses</b>	3	6+3	9
	<b>Total</b>	<b>59</b>	<b>84+54</b>	<b>138</b>
<b>Student READY</b>				
23.	Rural Agricultural Work Experience and Agro-Industrial Attachment (RAW&AIA)	1	0+20	20
24.	Experiential Learning Programme	2	0+20	20
	<b>Total</b>	<b>3</b>	<b>0+40</b>	<b>40</b>

<b>Non-Gradial courses</b>				
25.	Mathematics	1	0+1	1
26.	NSS /NCC	1	0+1	1
27.	PED	1	0+1	1
28.	Educational Tour	2	0+2	2
	<b>Total Non-Gradial courses</b>	<b>5</b>	<b>0+5</b>	<b>5</b>
	<b>Grand Total</b>	<b>67</b>	<b>84+99</b>	<b>183</b>
<b>Remedial Course</b>				
	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 101	Fundamentals of Agricultural Economics	2+0	II
2.	AEC 201	Farm Management, Production & Resource Economics	1+1	III
3.	AEC 202	Agricultural Marketing Trade & Prices	2+1	IV
4.	AEC 301	Intellectual Property Rights <sup>#</sup>	1+0	V
5.	AEC 302	Agricultural Finance and Cooperation	2+1	VI
		<b>TOTAL</b>	<b>8 + 3=11</b>	
AGRICULTURAL EXTENSION				
1.	AEX 101	Rural Sociology & Educational Psychology	2+0	I
2.	AEX 102	Fundamentals of Agricultural Extension Education	2+1	II
3.	AEX 301	Communication Skills and Personality Development	1+1	V
4.	AEX 302	Entrepreneurship Development and Business Management	1+1	VI
		<b>TOTAL</b>	<b>6 + 3=9</b>	
COMPUTER SCIENCE, STATISTICS AND ENGLISH				
1.	COM 101	Agri- Informatics	1+1	II
2.	STA 201	Statistical Methods	1+1	III
3.	ENG 101	Comprehension & Communication Skills in English	0+1	I
		<b>TOTAL</b>	<b>2 + 3=5</b>	

### DEPARTMENT OF AGRICULTURAL ENTOMOLOGY

Sl.No.	Course No.	Course Title	Cr.Hr.	Semester
1.	AEN 101	Fundamentals of Entomology	2+1	II
	AEN 201	Principles of Integrated Pest Management	1+1	III
2.	AEN 301	Pests of Crops and Stored Grain and their Management	2+1	V
3.	AEN 302	Management of Beneficial Insects	1+1	VI
		<b>TOTAL</b>	<b>6 + 4=10</b>	

### DEPARTMENT OF AGRONOMY

Sl.No.	Course No.	Course Title	Cr.Hr.	Semester
<b>AGRONOMY</b>				
1.	AGR 101	Fundamentals of Agronomy and Agricultural Heritage	2+1	I
2.	AGR 102	Introductory Agro-meteorology & Climate Change	1+1	II
3.	AGR 201	Irrigation Management	1+1	III
4.	AGR 202	Crop Production Technology – I ( <i>Kharif Crops</i> )	2+1	IV
5.	AGR 203	Farming System & Sustainable Agriculture	1+0	IV

6.	AGR 204	Geoinformatics and Nano-technology and Precision Farming <sup>#</sup>	1+1	IV
7.	AGR 302	Crop Production Technology –II ( <i>Rabi Crops</i> )	2+1	V
8.	AGR 301	Practical Crop Production – I ( <i>Kharif crops</i> )	0+1	V
9.	AGR 303	Rainfed Agriculture & Watershed Management	1+1	V
10.	AGR 304	Practical Crop Production –II ( <i>Rabi crops</i> )	0+1	VI
11.	AGR 305	Principles of Organic Farming	1+1	VI
		<b>TOTAL</b>	<b>12+10=22</b>	
<b>AGRICULTURAL ENGINEERING</b>				
1.	AEG 201	Farm Machinery and Power	1+1	III
2.	AEG 202	Soil and Water Conservation Engineering	1+1	IV
3.	AEG 301	Renewable Energy and Green Technology	1+1	V
4.	AEG 302	Protected Cultivation and Secondary Agriculture	1+1	VI
		<b>TOTAL</b>	<b>4 + 4=8</b>	
<b>ANIMAL HUSBANDRY</b>				
1.	AMP 201	Livestock and Poultry Management	2+1	III
			<b>2 + 1=3</b>	

### **DEPARTMENT OF HORTICULTURE**

Sl.No.	Course No.	Course Title	Cr.Hr.	Semester
<b>HORTICULTURE</b>				
1.	HOR 111	Fundamentals of Horticulture	1+1	I
2.	HOR 211	Production Technology for Vegetables and Spices	1+1	III
3.	HOR 212	Production Technology for Ornamental Crops, MAP and Landscaping	1+1	IV
4.	HOR 311	Production Technology for Fruit and Plantation Crops	1+1	V
5.	HOR 312	Post-harvest Management and Value Addition of Fruits and Vegetables	1+1	VI
		<b>TOTAL</b>	<b>5 + 5=10</b>	
<b>FORESTRY</b>				
1.	FOR 101	Introduction to Forestry	1+1	II
		<b>TOTAL</b>	<b>1 + 1=2</b>	
<b>FOOD SCIENCE</b>				
1.	FSN 301	Principles of Food Science and Nutrition	2+0	VI
		<b>TOTAL</b>	<b>2 + 0=2</b>	

### **DEPARTMENT OF PLANT BREEDING AND GENETICS**

Sl.No.	Course No.	Course Title	Cr.Hr.	Semester
<b>GENETICS AND PLANT BREEDING</b>				
1.	GPB 101	Fundamentals of Genetics	2+1	I
2.	GPB 201	Fundamentals of Plant Breeding	2+1	III
3.	GPB 202	Fundamentals of Plant Biotechnology	2+1	IV
4.	GPB 301	Crop Improvement	2+1	VI
		<b>TOTAL</b>	<b>8 + 4=12</b>	



SEED SCIENCE AND TECHNOLOGY				
1.	SST 201	Principles of Seed Technology	2+1	III
		TOTAL	2 + 1=3	
CROP PHYSIOLOGY				
1.	CRP 101	Fundamentals of Crop Physiology	2+1	I
		TOTAL	2 + 1=3	

### **DEPARTMENT OF PLANT PATHOLOGY & AGRICULTURAL MICROBIOLOGY**

Sl.No.	Course No.	Course Title	Cr.Hr.	Semester
PLANT PATHOLOGY				
1.	PAT 101	Fundamentals of Plant Pathology	2+1	II
	PAT 201	Principles of Integrated Disease Management	1+1	IV
2.	PAT 301	Diseases of Field and Horticultural Crops and their Management-I	2+1	V
3.	PAT 302	Diseases of Field and Horticultural Crops and their Management-II	2+1	VI
		TOTAL	7 + 4=11	
AGRICULTURAL MICROBIOLOGY				
1.	AGM 101	Agricultural Microbiology	2+1	I
		TOTAL		
NEMATOLOGY				
1.	ANM 201	Introductory Nematology	1+1	III
		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 201	Problematic Soils and their Management	1+1	III
3.	SAC 301	Manures, Fertilizers and Soil Fertility Management	2+1	V
		TOTAL	5+3=8	
BIOCHEMISTRY				
1.	BIC 101	Fundamentals of Biochemistry	1+1	II
		TOTAL	1 + 1=2	
ENVIRONMENTAL SCIENCE				
1.	ENS 101	Environmental Studies and Disaster Management <sup>#</sup>	2+1	II
		TOTAL	2 + 1=3	

### LIST OF ELECTIVE COURSES

Sl.No.	Course No.	Course Title	Cr.Hr	Semester
1.	AEC 251	Agribusiness Management	2+1	IV
2.	AEX 251	Agricultural Journalism	2+1	IV
3.	AGR 251	Weed Management	2+1	IV
4.	HOR 251	Landscaping	2+1	IV
1.	AGR 351	System Simulation and Agro-advisory	2+1	V
2.	GPB 351	Commercial Plant Breeding	2+1	V
3.	HOR 351	Protected Cultivation	2+1	V
1.	HOR 352	Hi-tech Horticulture	2+1	VI
2.	GPB 352	Micro Propagation Technologies	2+1	VI
3.	AGM352	Applied Microbiology	2+1	VI
4.	SAC 352	Agrochemicals	2+1	VI

### STUDENT READY

Sl.No.	Course No.	Course Title	Cr.Hr.	Semester
1.	RAE 401	Rural Agricultural Work Experience and Agro-Industrial Attachment (RAWE&AIA)	0+20	VII
		<b>TOTAL</b>	<b>0 + 20=20</b>	
<b>Experiential Learning Programme</b>				
1.	ELP 4XX	Experiential Learning Programme-1	0+10	VIII
2.	ELP 4XX	Experiential Learning Programme-2	0+10	VIII
		<b>TOTAL</b>	<b>0 + 20=20</b>	

### 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 <sup>#</sup>	0+10	VIII
5.	ELP 405	Organic Production Technology	0+10	VIII
6.	ELP 406	Integrated Farming System	0+10	VIII
7.	ELP 407	Poultry Production Technology	0+10	VIII
8.	ELP 408	Commercial Horticulture	0+10	VIII

9.	ELP 409	Floriculture and Landscape Architecture	0+10	VIII
10.	ELP 410	Molecular Breeding	0+10	VIII
11.	ELP 411	Plant Tissue Culture	0+10	VIII
12.	ELP 412	Commercial Seed Production	0+10	VIII
13.	ELP 413	Mushroom Cultivation Technology	0+10	VIII
14.	ELP 414	Bio-inoculants Production Technology	0+10	VIII
15.	ELP 415	Soil, Plant, Water, Manure and Fertilizers Testing	0+10	VIII
16.	ELP 416	Agriculture Waste Management	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
		<b>TOTAL</b>	<b>0 + 5=5</b>	

### **REMEDIAL COURSE**

Sl.No.	Course No.	Course Title	Cr.Hr.	Semester
1.	REM 101	Introductory Biology	0+1	I
		<b>TOTAL</b>	<b>0 + 1=1</b>	

# Team Teaching

**SEMESTER WISE DISTRIBUTION OF COURSES****SEMESTER I**

<b>Sl.No.</b>	<b>Course No.</b>	<b>Course Title</b>	<b>Cr.Hr.</b>
1.	AEX 101	Rural Sociology & Educational Psychology	2+0
2.	AGM 101	Agricultural Microbiology	2+1
3.	AGR 101	Fundamentals of Agronomy and Agricultural Heritage	2+1
4.	CRP 101	Fundamentals of Crop Physiology	2+1
5.	ENG 101	Comprehension & Communication Skills in English	0+1
6.	GPB 101	Fundamentals of Genetics	2+1
7.	HOR 111	Fundamentals of Horticulture	1+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
<b>TOTAL</b>			<b>13+10=23</b>

\*Non-Gradual Courses

**SEMESTER II**

<b>Sl.No.</b>	<b>Course No.</b>	<b>Course Title</b>	<b>Cr.Hr.</b>
1.	AEC 101	Fundamentals of Agricultural Economics	2+0
2.	AEN 101	Fundamentals of Entomology	2+1
3.	AEX 102	Fundamentals of Agricultural Extension Education	2+1
4.	AGR 102	Introductory Agro-meteorology & Climate Change	1+1
5.	BIC 101	Fundamentals of Biochemistry	1+1
6.	COM 101	Agri- Informatics	1+1
7.	ENS 101	Environmental Studies and Disaster Management	2+1
8.	FOR 101	Introduction to Forestry	1+1
9.	PAT 101	Fundamentals of Plant Pathology	2+1
	NSS 101 / NCC 101	National Social Service / National Cadet Corps*	0+1
	PED 101	Physical Education & Yoga Practices*	0+1
<b>TOTAL</b>			<b>14+8=22</b>

\*Non-Gradual Course continued from first semester

**SEMESTER III**

Sl.No.	Course No.	Course Title	Cr.Hr.
1.	AEC 201	Farm Management, Production & Resource Economics	1+1
2.	AEG 201	Farm Machinery and Power	1+1
3.	AEN 201	Principles of Integrated Pest Management	1+1
4.	AGR 201	Irrigation Management	1+1
5.	AMP 201	Livestock and Poultry Management	2+1
6.	ANM 201	Introductory Nematology	1+1
7.	GPB 201	Fundamentals of Plant Breeding	2+1
8.	HOR 211	Production Technology for Vegetables and Spices	1+1
9.	SAC 201	Problematic Soils and their Management	1+1
10.	SST 201	Principles of Seed Technology	2+1
11.	STA 201	Statistical Methods	1+1
	NSS 101 / NCC 101	National Social Service / National Cadet Corps*	0+1
	PED 101	Physical Education & Yoga Practices*	0+1
TOTAL			14+11=25

\*Non-Gradual Course continued from first semester

**SEMESTER IV**

Sl.No.	Course No.	Course Title	Cr.Hr.
1.	AEC 202	Agricultural Marketing Trade & Prices	2+1
2.	AEG 202	Soil and Water Conservation Engineering	1+1
3.	AGR 202	Crop Production Technology – I ( <i>Kharif Crops</i> )	2+1
4.	AGR 203	Farming System & Sustainable Agriculture	1+0
5.	AGR 204	Geoinformatics and Nano-technology and Precision Farming	1+1
6.	GPB 202	Fundamentals of Plant Biotechnology	2+1
7.	HOR 212	Production Technology for Ornamental Crops, MAP and Landscaping	1+1
8.	PAT 201	Principles of Integrated Disease Management	1+1
9.		Elective Course-1	2+1
10.	PJN 201	Educational Tour - I (State)#	0+1
	NSS 101 / NCC 101	National Social Service / National Cadet Corps*	0+1
	PED 101	Physical Education & Yoga Practices*	0+1
TOTAL			13+9=22

\*Non-Gradual Course continued from first semester

# Non-Gradual Course

**SEMESTER V**

Sl.No.	Course No.	Course Title	Cr.Hr.
1.	AEC 301	Intellectual Property Rights #	1+0
2.	AEG 301	Renewable Energy and Green Technology	1+1
3.	AEN 301	Pests of Crops and Stored Grain and their Management	2+1
4.	AEX 301	Communication Skills and Personality Development	1+1
5.	AGR 301	Practical Crop Production – I ( <i>Kharif</i> crops)	0+1
6.	AGR 302	Crop Production Technology –II ( <i>Rabi Crops</i> )	2+1
7.	AGR 303	Rainfed Agriculture & Watershed Management	1+1
8.	HOR 311	Production Technology for Fruit and Plantation Crops	1+1
9.	PAT 301	Diseases of Field and Horticultural Crops and their Management-I	2+1
10.	SAC 301	Manures, Fertilizers and Soil Fertility Management	2+1
11.	---	Elective Course-2	2+1
TOTAL			15+10=25

# Team teaching

**SEMESTER VI**

Sl.No.	Course No.	Course Title	Cr.Hr.
1.	AEC 302	Agricultural Finance and Cooperation	2+1
2.	AEG 302	Protected Cultivation and Secondary Agriculture	1+1
3.	AEN 302	Management of Beneficial Insects	1+1
4.	AEX 302	Entrepreneurship Development and Business Management	1+1
5.	AGR 304	Practical Crop Production –II ( <i>Rabi</i> crops)	0+1
6.	AGR 305	Principles of Organic Farming	1+1
7.	FSN 301	Principles of Food Science and Nutrition	2+0
8.	GPB 301	Crop Improvement	2+1
9.	HOR 312	Post-harvest Management and Value Addition of Fruits and Vegetables	1+1
10.	PAT 302	Diseases of Field and Horticultural Crops and their Management-II	2+1
11.	---	Elective Course-3	2+1
TOTAL			15+10=25

**SEMESTER VII**

<b>Sl.No.</b>	<b>Course No.</b>	<b>Course Title</b>	<b>Cr.Hr.</b>
1.	RAE 401	Rural Agricultural Work Experience and Agro-Industrial Attachment (RAWE&AIA)	0+20
2.	PJN 401	Educational Tour - II (All India)*	0+1
<b>TOTAL</b>			<b>0+21</b>

\* Non-Gradial Course

**SEMESTER VIII**

<b>Sl.No.</b>	<b>Course No.</b>	<b>Course Title</b>	<b>Cr.Hr.</b>
1.	ELP XXX	Experiential Learning Programme 1	0+10
2.	ELP XXX	Experiential Learning Programme 2	0+10
<b>TOTAL</b>			<b>0+20</b>

**ABSTRACT**

<b>Year</b>	<b>Semester</b>	<b>No. of Courses</b>	<b>Theory</b>	<b>Practical</b>	<b>Total</b>
First	I	11	13	10	23
	II	9	14	8	22
Second	III	11	14	11	25
	IV	10	13	9	22
Third	V	11	15	10	25
	VI	11	15	10	25
Fourth	VII	2	0	21	21
	VIII	2	0	20	20
<b>TOTAL</b>		<b>67</b>	<b>84</b>	<b>99</b>	<b>183</b>

### I SEMESTER

Sl.No.	Course No.	Course Title	Cr.Hr.
1.	AEX 101	Rural Sociology & Educational Psychology	2+0
2.	AGM 101	Agricultural Microbiology	2+1
3.	AGR 101	Fundamentals of Agronomy and Agricultural Heritage	2+1
4.	CRP 101	Fundamentals of Crop Physiology	2+1
5.	ENG 101	Comprehension & Communication Skills in English	0+1
6.	GPB 101	Fundamentals of Genetics	2+1
7.	HOR 111	Fundamentals of Horticulture	1+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			13+10=23

\*Non-Gradual Courses



## **AEX 101 RURAL SOCIOLOGY AND EDUCATIONAL PSYCHOLOGY (2+0)**

### **Outcomes :**

- In depth understanding of importance of Rural Sociology in Agricultural Extension
- Understanding of importance of Educational Psychology in Agricultural Extension

### **Unit I : Extension and Rural Sociology**

Extension Education and Agricultural Extension – Meaning, Definition, Scope and Importance. Sociology and Rural Sociology, Meaning Definition, Scope, Importance of Rural Sociology in Agricultural Extension and Interrelationship between Rural Sociology & Agricultural Extension. Indian Rural Society, Important characteristics, Differences and Relationship between Rural and Urban societies.

### **Unit II : Social institutions and Groups**

Social ecology, Social Institutions – Meaning, Definition, Major institutions in Rural society and importance in Agricultural Extension. Social Organizations – Meaning, Definition, Types and Role in Agricultural Extension. Social Groups – Meaning, Definition, Classification, Factors in formation and organization of groups, Motivation in group formation and role in Agricultural Extension. Social Stratification – Meaning, Definition, Basis for stratification, Class & Caste System.

### **Unit III : Culture, social values and social change**

Cultural concepts – Culture, Customs, Folkways, Mores, Taboos, Rituals and Traditions – Meaning, Definition and their Role in Agricultural Extension. Social Values and Attitudes – Meaning, Definition, Types and Role of Social Values and Attitudes in Agricultural Extension. Social interaction process, Social change – Meaning, Definition, Nature of Social change, Dimensions of social change and factors of social change. Social development.

### **Unit IV : Extension and Educational Psychology**

Psychology and Educational Psychology – Meaning, Definition, Scope and Importance of Educational Psychology in Agricultural Extension. Intelligence – Meaning, Definition, Types, Factors affecting intelligence and Importance of intelligence in Agricultural Extension. Personality – Meaning, Definition, Types, Factors influencing the Personality and Role of personality in Agricultural Extension. Motivation and theories of motivation.

### **Unit V : Human Behaviour and Teaching- Learning**

Principles of human behavior - Teaching – Learning process – Meaning and Definition of Teaching, Learning, Principles of learning and their implication for teaching. Types and theories of learning, Learning experience and Learning situation, Elements of learning situation and its characteristics, adult learning.

### **Lecture Schedule :**

1. Extension Education and Agricultural Extension – Meaning, Definition, Scope and Importance.
2. Sociology and Rural Sociology, Meaning Definition, Scope, Importance and significance of Rural Sociology in Agricultural Extension

3. Indian Rural Society, Important characteristics, Differences and Relationship between
4. Rural and Urban societies.
5. Society & Community Definition, elements and differences.
6. Social ecology, components, Social Institutions – Meaning, Definition, functions and role of major institutions in rural society.
7. Social Organizations – Meaning, Definition, Types of organizations and Role of Social organizations in Agricultural Extension.
8. Family – Definition, types, characteristics and functions.
9. Social Groups – Meaning, Definition, Classification, characteristics of primary and secondary groups.
10. Factors considered in formation and organization of groups, Motivation in group formation and Role of Social groups in Agricultural Extension.
11. Social Stratification – Meaning, Definition, Functions, Basis for stratification, Forms of Social stratification
12. Social class – definition, meaning, characteristics and – Differences between Class & Caste System.
13. Culture, Customs, Folkways, Mores, Taboos, Rituals and Traditions – Meaning, Definition and their Role in Agricultural Extension. Social control and means of social control.
14. Cultural diffusion, Cultural lag, Ethnocentrism - Meaning, Definition and their Role in Agricultural Extension.
15. Social Values and Attitudes – Meaning, Definition, Types and Role of Social Values and Attitudes in Agricultural Extension.
16. Social Interaction Process - Aspects of Social Interaction, Major Basic Social Processes.
17. Social change – Meaning, Definition, Nature of Social change. Dimensions of social change and factors of social change, Social development process and its importance.
- 18. Mid semester**
19. Psychology- Meaning, Definition and Branches of Psychology  
Educational Psychology – Meaning, Definition, Scope and Importance of Educational Psychology in Agricultural Extension.
20. Human Behaviour – S-R Mechanisms, basic principles of human behavior, cognitive, affective and psychomotor domains.
21. Sensation – Types, characteristics and determinants.
22. Attention – Factors, characteristics of attention.
23. Perception – characteristics, determinants, errors of perception.
24. Teaching – Learning process – Meaning and Definition of Teaching, Learning, Principles of learning and their implication for teaching.
25. Learning experience and Learning situation, Elements of learning situation and its characteristics.
26. Types of learning.
27. Theories of learning.
28. Adult – characteristics, their implication in extension teaching.
29. Intelligence – Meaning, Definition, Measurement, Factors affecting intelligence and Importance in Agricultural Extension.
30. Personality – Meaning, Definition, Types, Factors influencing the Personality and Role of personality in Agricultural Extension.

31. Motivation – Meaning, Definition and types and importance in extension  
Theories of Motivation.

**References**

1. Introductory Rural Sociology – Chitambar, J.B.1997, Wiley Eastern Limited, New Delhi
2. An Introductory to Sociology – Vidya Bhushan and Such Deva, D.R. 2003. Kitab Mahal, Allahbad.
3. Extension Education – Adivi Reddy, A 2001 Sree Lakshmi Press, Bapatla – 522 101, New Delhi.
4. Education Psychology – Kundu C.L and Tutoo D.N, 2001 Sterling Publishers Pvt. Ltd, New Delhi
5. Educational Psychology – Mangal S.K.2000, Prakash Brothers, Ludhiana
6. Advanced Educational Psychology – Chatterjee S 2000, Books & Allied (P) Ltd, Calcutta.
7. Advanced Educational Psychology – Chauhan SS 2001, Vikas Pub House Pvt. Ltd., New Delhi.

**Journals**

1. Journals of Advances in Social Work
2. Journal of Asian Social Sciences
3. Journal of Social Sciences and Research
4. Journal of Current Research in Social Psychology

**Web resources**

1. [www.ijsaf.org](http://www.ijsaf.org)
2. [www.ag.auburn.edu](http://www.ag.auburn.edu)
3. [www.doaj.org](http://www.doaj.org)
4. [www.iccssr.org](http://www.iccssr.org)

**Outcomes :**

- In depth understanding of Microorganisms in Living world, Groups of Micro-organisms
- Understanding importance Soil microorganism in soil fertility, Microbial transformation of nutrients in soil and bio-fertilizers in agriculture.

**Theory****Unit I: History of Microbiology and Microscopy**

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; Prokaryotes Vs Eukaryotes; Groups of microorganisms; Bacterial size, shape, arrangement and morphology; Structure and organization of a bacterial cell; Microscopy – principles and types.

**Unit II: Microbial physiology, metabolism and genetics**

Bacterial growth, reproduction and factors influencing bacterial growth – Growth curve; Nutritional types and metabolic diversity of bacteria; Principles of energy generation and carbon metabolism; fermentation–respiration in bacteria. Bacterial viruses – Lytic and Lysogenic cycles; Genetic recombination-transformation, conjugation, transduction.

**Unit III: Soil Microbiology**

Distribution and importance of soil microorganisms in soil fertility - factors affecting the activities of soil microorganisms; Rhizosphere microorganisms and Importance; Phyllosphere microorganisms - Plant-microbe and microbe-microbe interactions in soil.

**Unit IV: Microbial transformation of nutrients in soil**

Microbial transformation of nutrients in soil - Carbon, Phosphorous and Sulphur cycle; Nitrogen cycle, Biological nitrogen fixation - symbiotic and non-symbiotic microorganisms, Process of nodulation and nitrogen fixation; Silicate and zinc solubilising bacteria; Mycorrhizae.

**Unit V: Applied Microbiology**

Types and importance of biofertilizers in agriculture; Mass production and quality control of biofertilizers; Microbes in human welfare – silage production: Microbial insecticides and biocontrol agents; Biogas and biofuel production; Biodegradation of agro wastes.

**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; Morphological and biochemical characters of bacteria. Organic matter decomposition – measurement of CO<sub>2</sub> evolution; Isolation of N<sub>2</sub> fixing and phosphate solubilizing microorganisms; Examination of BGA from soil and Azolla; Mass production of biofertilizers – method of application of biofertilizers.

## Theory schedule

1. Definition and scope of Microbiology - Spontaneous Generation theory.
2. Contributions of Anton Van Leeuwenhoek, Louis Pasteur, John Tyndall, Robert Koch, Edward Jenner, Joseph Lister, Beijerinck, Winogradsky and Waksman – Germ theory of fermentation and disease.
3. Position of microorganisms in living world; Prokaryotes Vs Eukaryotes.
4. Bacterial morphology - arrangement of cells, structures.
5. Functional anatomy and reproduction in bacteria.
6. Microscopy: principles - different types of microscopy.
7. Bacterial growth - Growth curve – generation time and growth rate.
8. Environmental conditions for growth – Temperature – psychrophiles, mesophiles and thermophiles; air – aerobic and anaerobic; pH- acidic and alkali; salt.
9. Nutritional types of bacteria - autotrophs, heterotrophs, phototrophs and chemolithotrophs.
10. Microbial metabolism – principles of energy generation - Phosphorylation.
11. Respiration – fermentation.
12. Outline classification of bacteria – Bergey's Manual of Systematic Bacteriology Edn. II
13. Bacteriophages – Lytic and Lysogenic cycles.
14. Genetic recombination – Transformation, Conjugation and Transduction.
15. Diversity of soil microorganisms-bacteria, actinomycetes, fungi and algae- factors influencing the microbial diversity and activity.
16. Rhizosphere microorganisms- R: S ratio and importance.
17. Mid Semester Examination.
18. Plant growth promoting rhizobacteria; Phyllosphere microbiology and Methylophiles.
19. Microbial interactions in soil - neutralism, positive and negative interactions.
20. Microbial transformation of nutrients in soil – Carbon cycle.
21. Organic matter decomposition- aerobic and anaerobic - Importance of C: N ratio in soil fertility - humus formation.
22. Microbial transformation of nutrients in soil – Nitrogen cycle
23. Biological nitrogen fixation - symbiotic and non-symbiotic microorganisms.
24. Process and genetics of nodulation and nitrogen fixation.
25. Microbial transformation of nutrients in soil - Phosphorous & Sulphur.
26. Silicate and zinc solubilizing microorganisms; Mycorrhizae.
27. Types of biofertilizers and importance in agriculture.
28. Production and quality control of biofertilizers and methods of application of biofertilizers.
29. Silage and Biogas production.
30. Biomass to Biofuel production-ethanol production.
31. Microbial insecticides and microbial agents for pest and plant disease control.
32. Biodegradation of agro-wastes:composting-types.

## Practical schedule

1. Microscopy- principles - handling light microscope.
2. Staining - principles and techniques-Simple staining: positive and negative staining
3. Differential staining
4. Sterilization- principles and techniques - equipment and apparatus used for sterilization

5. Media preparation for bacteria, fungi and actinomycetes
6. Enumeration of soil microorganisms- serial dilution plate technique (bacteria, fungi, and actinomycetes)
7. Purification of bacteria & fungi
8. Growth of bacteria - turbidimetric method.
9. Morphological and biochemical characters of bacteria.
10. Organic matter decomposition - measurement of CO<sub>2</sub> evolution.
11. Isolation of symbiotic N<sub>2</sub> fixing microorganism – Rhizobium
12. Isolation of associative and non symbiotic N<sub>2</sub> fixer: Azospirillum and Azotobacter
13. Isolation of phosphate solubilizing microorganisms.
14. Examination of BGA from soil and Azolla
15. Mass production of biofertilizers
16. Method of application of biofertilizers
17. Final Practical Examination

### Further reading

1. Black, J.G. 2005. Microbiology: Principles and Explorations, John Wiley, USA.
2. Michael Madigan, John Martinko, Kelly S. Bender and Jack Parker. 2014. Brock Biology of Microorganisms. 14th Edition. Benjamin Cummings. England.
3. Prescott, M.J., Harley, J.P. and Klein, D.A. 2002. Microbiology. 5th Edition, WCB Mc Graw Hill, New York.
4. Stanier, R.Y., Ingraham, J.L., Wheelis, M.L. & Painter, P.R. 1987. *General Microbiology, Fifth Edition*. MacMillan: [i]-xiv, 1-689. [Reprinted 1989]
5. Pelczar MJ, Chan ECS and Kreig NR. 1998. Microbiology, 5th edition. Tata McGraw-Hill.
6. Singh, T. Purohit, S. S. and Parihar, P. Soil Microbiology. 2010. Mrs. Saraswati Purohit. India.
7. Subba Rao, N.S. 2006. Soil Microbiology (4th Edition of Soil Microbiology and Plant Growth). Oxford & IBH, New Delhi.

### Web resources

<http://www.microbes.info>

<http://aem.asm.org>

<http://microbelibrary.com>

<http://www.rapidmicrobiology.com>

Kenneth Todar, U. of Wisconsin-Madison, Department of Bacteriology. URL (<http://www.textbookofbacteriology.net/>).

## **AGR 101 FUNDAMENTALS OF AGRONOMY AND AGRICULTURAL HERITAGE (2+1)**

### **Outcomes :**

- Understanding the importance and scope of Agriculture as Art, Science and Business.
- Knowledge about Agro ecological zones of India and Tamil.
- Understanding factors affecting crop production

### **Theory:**

#### **Unit I: Agriculture and Agronomy**

Agriculture – Definition – Importance and scope - Agriculture as Art, Science and Business – Branches of agriculture - Development of scientific Agriculture - National and International Agricultural Research Institutes - Indian agriculture - Indian economy - National income – Women in agriculture. Agronomy – Definition, meaning and its scope – Agro-climatic zones of India and Tamil Nadu – Agro ecological zones of India and Tamil Nadu.

#### **Unit II: Agricultural Heritage**

Introduction of Indian agricultural heritage; Relevance of heritage to present day agriculture – Agriculture in ancient India – Stages of agriculture development - Era of civilization- Importance of Neolithic civilization - Kautilya's Arthashastra - Sangam literature - Indigenous Technical Knowledge (ITK).

#### **Unit III: Tillage and sowing**

Major soils of India, Tamil Nadu and Puducherry – Growth and development of crops, factors affecting growth and development - climatic - edaphic- biotic - physiographic and socio economic factors; plant ideotypes. Tillage and tillage – Definition – Types, objectives and modern concepts of tillage – Main field preparations - Seeds and sowing - seed rate- sowing methods - Germination – Factors affecting germination - Crop stand establishment - Crop density and geometry - its effect on growth and yield - After cultivation – Thinning - Gap filling – Inter cultural operations.

#### **Unit IV: Crop nutrition and weed management**

Crop nutrition, manures and fertilizers – classification, time and method of fertilizer application. Nutrient use efficiency (NUE) - Agronomic interventions for enhancing NUE. Weeds- importance, classification, crop weed competition, concepts of weed management- principles and methods, herbicides- classification, selectivity and resistance, allelopathy, – IWM .

#### **Unit V: Irrigation and Cropping system**

Irrigation - Time and methods of irrigation - Modern techniques of irrigation - Drainage and its importance - Irrigated farming and Dry farming - Concepts and principles Cropping patterns and cropping systems - intensive cropping - Crop rotation and its principles - adaptation and distribution of crops - Sustainable agriculture - integrated farming systems - Farm enterprises; Organic agriculture - Concepts and principles; Crop management technologies in problematic areas; harvesting and threshing of crops.

**Practical:**

Identification of crops, seeds, fertilizers, pesticides and tillage implements, study of agro-climatic zones of India, Identification of weeds in crops, Methods of herbicide and fertilizer application, Study of yield contributing characters and yield estimation, Seed germination and viability test, Numerical exercises on fertilizer requirement, plant population and herbicide requirement. Use of tillage implements-reversible plough, one way plough, harrow, leveler, seed drill.

**Lecture Schedule:**

1. Agriculture – Definition – Importance and scope - Agriculture as Art, Science and Business
2. Branches of agriculture - Development of scientific agriculture - National and International Agricultural Research Institutes
3. Indian agriculture – Indian economy - National income
4. Women in agriculture – multifaceted roles and tasks.
5. Agronomy – Definition – Meaning and its scope
6. Agro-climatic zones of India and Tamil Nadu – Agro ecological zones of India and Tamil Nadu.
7. Agriculture heritage – Relevance of heritage to present day agriculture. Agriculture in ancient India.
8. Stages of agriculture development- History of agricultural development in world and India.
9. Era of civilization -Importance of Neolithic civilization
10. Kautilya's Arthashastra- Sangam literature
11. Indigenous Technical Knowledge (ITK)
12. Major soils of India, Tamil Nadu and Puducherry; Growth and development of crops
13. Factors affecting crop production – climatic and edaphic factors.
14. Factors affecting crop production – biotic, physiographic and socio economic factors; plant ideotypes.
15. Tillage – Definition – Objectives – Types of tillage – Main field preparations
16. Modern concepts of tillage
17. **MID-SEMESTER EXAMINATION**
18. Seeds - seed rate - sowing methods; Germination – Factors affecting germination - Crop stand establishment
19. Crop density and geometry - its effect on growth and yield - After cultivation – Thinning - Gap filling – Inter cultural operations
20. Crop nutrition – essential elements – classification of essential elements based on requirement. Manures and fertilizers – meaning and their role in crop production
21. Classification of manures and fertilizers - Time and methods of application of manures and fertilizers
22. Nutrient use efficiency – Agronomic interventions for enhancing nutrient use efficiency.



23. Weeds – Definition – Harmful and beneficial effects of weeds
24. Classification of weeds – crop weed competition and concept of weed management
25. Principles and methods of weed management
26. Herbicides – meaning, classification, selectivity and resistance Allelopathy and IWM.
27. Irrigation - Time and methods of irrigation - Modern techniques of irrigation - Drainage and its importance
28. Irrigated farming and Dry farming- Concepts and principles.
29. Cropping patterns and cropping systems - Intensive cropping - Crop rotation and its principles
30. Adaptation and distribution of crops - Sustainable agriculture- Integrated farming systems - Farm enterprises.
31. Organic / eco-friendly agriculture - Concepts and principles
32. Crop management technologies in acid, saline and sodic soils – Harvesting and threshing of crops

**Practical schedule:**

1. Visit to college farm to observe farming system and identification of crops
2. Study of some basic terminologies and units in agriculture
3. Identification of seeds, manures and fertilizers
4. Identification of tools and implements and acquiring skill in ploughing and puddling.
5. Acquiring skill in handling primary tillage implements
6. Acquiring skill in handling secondary tillage implements
7. Raising nursery for wet land and garden land crops
8. Working out seed rates for crops.
9. Study of seed germination and viability tests.
10. Study of different methods of seed treatments, methods of sowing and seeding implements
11. Practicing thinning, gap filling operations for optimum crop stand and inter-cultural operations
12. Working out manure and fertilizer requirement of crops and manures acquiring skill on application of manures and fertilizers
13. Study of green manures and green leaf manures and their incorporation.
14. Identification of weeds, weeding practices and handling of weeding tools and implements
15. Practicing harvesting operations in major field crops
16. Participation in on-going field operations during on campus /off campus visit
17. **FINAL PRACTICAL EXAMINATION**

**References:**

1. ICAR. 1996. Handbook of Agriculture. Indian Council of Agricultural Research, New Delhi.

2. Morachan, Y.B. 1980. Crop Production and Management. Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi.
3. Reddy, S.R. 1999. Principles of Agronomy. Kalyani Publishers, New Delhi
4. Sankaran, S. and V.T. Subbiah Mudaliar. 1997. Principles of Agronomy. The Bangalore Printing and Publishing Co. Ltd., Bangalore.
5. Singh, S.S 1998. Principles and Practices of Agronomy. Kalyani Publishers, New Delhi.
6. Yellamananda Reddy, T. and G.H. Sankara Reddi 1997. Principles of Agronomy. Kalyani Publishers, New Delhi.
7. Balsubramaniyan, P. and SP. Palaniappan, 2001. Principles and Practices of Agronomy. Agrobios. Jodhpur - 342 002.
8. Panda, S.C. 2005. Agronomy. Agrobios (India), Jodhpur - 342 002.
9. Chandrasekaran, B., K. Annadurai and E. Somasundaram. 2010. A Textbook of Agronomy. New Age International Publishers, New Delhi.

## CRP101 FUNDAMENTALS CROP PHYSIOLOGY (2 + 1)

### Outcomes:

- Understanding importance of crop physiology in Agriculture, Functions of Plant nutrients, Deficiency symptoms of plant nutrients.
- Understanding role of physiological growth parameters in crop productivity

**UNIT I:** Introduction to crop physiology and its Importance in Agriculture. Plant Cell – an overview; Diffusion and osmosis. **Water Relations** - Physiological importance of water to plants, Soil water availability, Water absorption, Water potential and its components,. Transpiration - significance, Transpiration in relation to crop productivity, Stomatal physiology – Concept of Water Use Efficiency.

**UNIT II: Mineral Nutrition of plants** – Definition– criteria of essentiality - classification of plant nutrients – Functions of plant nutrients – Deficiency symptoms of plant nutrients – nutrient uptake mechanisms – membrane transporters and carriers - Foliar nutrition – fertigation - Hydroponics.

**UNIT III: Photosynthesis** – Light and dark reactions – photosynthetic pathway of C<sub>3</sub>, C<sub>4</sub> and CAM pathway, Relationship of Photosynthesis and crop productivity - Translocation of assimilates, Phloem loading, apoplastic and symplastic transport of assimilates, source and sink concept - Photorespiration, Factors affecting Photosynthesis, Photosynthetic efficiency. **Respiration** – aerobic - Glycolysis, TCA cycle and electron transport chain – anerobic Brief account of Growth respiration and maintenance respiration, Alternate respiration – respiratory quotient. **Fat metabolism** - fatty acid synthesis and breakdown.

**UNIT IV: Growth and Development** - Plant Growth Regulators – definition – classification – biosynthetic pathway and formative effects of Auxins, Gibberellins, Cytokinins, ABA, Ethylene. Novel plant growth regulators and growth retardant, Commercial uses of plant growth regulators in agriculture. Physiological aspects of growth and development of major crops – photoperiodism – phytochromes - vernalisation – seed dormancy, seed viability and seedling vigour – basic concepts. Senescence and abscission – Definition –associated physiological and biochemical changes. Physiology of fruit ripening - Climacteric and non - climacteric fruits. Growth analysis - Role of physiological growth parameters in crop productivity.

**UNIT V: Stress Physiology** – Abiotic stresses – water, temperature and salt stress – physiological changes and adaptation

**Practical :** Study of plant cells, structure and distribution of stomata – frequency and index - Preparation of standard solutions; Methods of measuring water status in plants transpiration rate; Separation of photosynthetic pigments – estimation of chlorophyll pigments – Measurement of photosynthesis by IRGA, respiration. Deficiency symptoms of nutrients and their identification – tissue test for nutrients. Growth analysis – leaf area estimation & Calculation of growth parameters; Bioassay for hormones. Estimation of relative water content, chlorophyll stability index and proline content.

## Lecture Schedule

1. Introduction and importance of Crop Physiology in Agriculture, an over view of Plant cell.
2. Structure and role of water – water potential and its components – Diffusion – Osmosis – imbibition – Plasmolysis - Field Capacity and Permanent Wilting Point
3. Mechanisms of water absorption – Pathways of water movement – Apoplast and symplast
4. Translocation of water – ascent of sap – mechanisms of xylem transport
5. Transpiration – significance – Stomatal physiology: structure of stomata with mechanisms of stomatal opening and closing – guttation – antitranspirants – role in crop productivity
6. Mineral nutrition of plants – criteria of essentiality - classification of nutrients – macro, micro, mobile and immobile – beneficial elements, mechanism of nutrient uptake – membrane transporters and carriers.
7. Physiological functions and disorders of macronutrients, Hidden hunger
8. Physiological functions and disorders of micronutrients
9. Foliar nutrition - fertigation – sand culture, hydroponics and aeroponics
10. Light reaction of photosynthesis – photolysis of water and photophosphorylation - Z scheme
11. Dark Reaction of photosynthesis -  $C_3$ ,  $C_4$  and CAM pathways and differences.
12. Factors affecting photosynthesis - Photorespiration – pathway and its significance
13. Phloem transport – Munch hypothesis - Phloem loading and unloading - Source and sink strength and their manipulations
14. Respiration - Glycolysis – TCA cycle - oxidative phosphorylation - Electron transport chain
15. Anaerobic respiration – Pentose Phosphate pathway – Growth and maintenance respiration - Alternate respiration - respiratory quotient.
16. Fat metabolism: fatty acid synthesis and breakdown
17. **MID SEMESTER EXAMINATION**
18. Growth – phases of growth – factors affecting growth.
19. Hormones and plant growth regulators (PGR): physiological roles and agricultural uses - Biosynthetic pathway and role of auxins and gibberellins
20. Plant growth regulators (PGR): physiological roles and agricultural uses - Biosynthetic pathway and role of cytokinin, ethylene and ABA
21. Novel growth regulators viz., Brassinosteroids and salicylic acid – New Generation PGRs - Growth retardants and inhibitors - commercial uses of PGRs
22. Photoperiodism - short, long and day neutral plants – Chailakhyan's theory of flowering
23. Forms of phytochrome - Pr and Pfr - regulation of flowering
24. Vernalisation - theories of vernalisation – Lysenko and Hormonal theories – devernialization
25. Physiological aspects of growth and development of major crops
26. Growth analysis – role of physiological growth parameters in crop productivity
27. Seed dormancy, seed viability and seedling vigour – basic concepts - Seed germination - seed dormancy and breaking methods
28. Senescence and abscission – physiological and biochemical changes
29. Physiology of fruit ripening- climacteric and non climacteric fruits - factors affecting ripening and manipulations
30. Role of physiological growth parameters in crop productivity
31. Drought - physiological changes - adaptation – compatible osmolytes - alleviation

32. High and low temperature stress – physiological changes - membrane properties – adaptation - Salt stress - physiological changes - adaptation – compartmentalization - alleviation

### **Practical schedule**

1. Preparation of solutions
2. Study of leaf epidermal, xylem and phloem cells
3. Determination of stomatal index and stomatal frequency
4. Measurement of plant water potential
5. Estimation of leaf area by different methods
6. Estimation of photosynthetic pigments
7. Determination of photosynthetic efficiency in crops
8. Measurement of transpiration and photosynthesis by IRGA
9. Diagnosis of nutritional and physiological disorders in crops
10. Rapid tissue test for mineral nutrients
11. Estimation of relative water content
12. Measurement of osmosis and plasmolysis
13. Growth Analysis
14. Bioassay for gibberellin and cytokinin
15. Estimation of chlorophyll stability index
16. Estimation of proline content
17. FINAL PRACTICAL EXAMINATION

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## ENG 101 Comprehension and Communication Skills in English (0+1)

### Outcomes:

- Understanding the concepts of listening comprehension, oral communication.
- Understanding the principles and practice of presentation skills, writing skills and interview skills.

### 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 overcome them – 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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4. [www.bogglesworld.com](http://www.bogglesworld.com)
5. [www.eltweb.com](http://www.eltweb.com)
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7. [www.writing-skills.com](http://www.writing-skills.com)
8. [www.negotiation.com](http://www.negotiation.com)
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## **GPB 101 FUNDAMENTALS OF GENETICS (2+1)**

### **Outcomes:**

- In-depth understanding of cytology, Mendelian laws and modifications of Mendelian Laws.
- Understanding the concepts of quantitative inheritance, linkage, crossing over, sex determination, sex linkage and cytoplasmic inheritance.

### **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, B chromosomes, 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 Punnett. 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 Monod – *Lac* and *Trp* operons. Fine structure of gene; *r<sup>ll</sup>* locus. Benzer experiments, Concept of Cistron, muton and recon. Mutation – characteristics of mutation – micro and macro mutation – *C/B* 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<sub>2</sub> 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- value: 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, B chromosomes, 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;
8. Polyploid - auto and allopolyploids, their characters.
9. 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.
10. Chromosomal theory of inheritance. Allelic interactions – Dominance vs recessive, complete dominance, codominance, incomplete dominance, threshold characters.
11. 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).
12. Duplicate dominant epistasis (15:1), Duplicate recessive epistasis (9:7), Dominant and recessive epistasis (13:3); Summary of epistatic ratios.
13. Lethal genes, Pleiotrophy, penetrance and expressivity, Multiple alleles, blood group in humans, coat colour in rabbits, self-incompatibility in plants; pseudo alleles, isoalleles.
14. Quantitative inheritance – Multiple factor hypothesis – Nilsson Ehle experiment on wheat kernel colour.
15. Polygenes – transgressive segregation, comparison of quantitatively and qualitatively inherited characters; modifiers.
16. Linkage - coupling and repulsion; Experiment of Bateson and Punnett
17. Chromosomal theory of linkage of Morgan – Complete and incomplete linkage, Linkage group.

#### **MID SEMESTER EXAMINATION**

1. Crossing over – significance of crossing over; cytological proof for crossing over - Stern's experiment; Factors controlling crossing over.
2. Strength of linkage and recombination; Two point and three point test cross. Double cross over, interference and coincidence; genetic map, physical map.
3. 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.
4. Genic balance theory of Bridges - Gynandromorphs
5. Sex linked inheritance – criss cross inheritance – reciprocal difference; holandric genes; sex influenced and sex limited inheritance - Genetic disorders
6. 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
7. DNA, the genetic material – Griffith's experiment, experiment of Avery, McCleod and McCarthy.
8. Confirmation by Hershey and Chase; RNA as genetic material – Frankel, Conrat and Singer experiment.
9. Structure of DNA – Watson and Crick model. Central dogma of life. Proof for semi conservative method of DNA replication; Models of DNA replication.
10. DNA replication: steps involved in DNA replication. Transcription: RNA types - mRNA, tRNA, rRNA.

11. Translation: Steps involved in protein synthesis
12. Regulation of gene expression – Operon model of Jacob and Monod – *Lac* and *Trp* operons.
13. Fine structure of gene; *r<sup>II</sup>* locus. Benzer experiments, Concept of Cistron, muton and recon.
14. Mutation – characteristics of mutation – micro and macro mutation – *C/B* technique.
15. 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, Duplicate and additive epistasis.
  - a. Duplicate dominant epistasis, Duplicate recessive epistasis, Dominant and recessive epistasis.
9. Multiple alleles and polygenic inheritance
10. Estimation of linkage with  $F_2$  and test cross data; Coupling and repulsion.
11. Problems on three point test cross; working out interference, coincidence and drawing genetic maps.
12. Problems in cytoplasmic/ maternal inheritance.
13. Problems in sex linked inheritance in Humans and *Drosophila*.
14. Problems in DNA replication, transcription and translation.
15. Problems in gene regulation/ Mutation.
16. **FINAL PRACTICAL EXAMINATION**

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**HOR 111**

**FUNDAMENTALS OF HORTICULTURE**

**1+1**

### **Outcomes:**

- Understanding basics of Horticulture, propagation and use of growth regulators.
- Understanding principles of Orchard establishment and management.
- Understanding problem of unfruitfulness and their remedy in horticultural crops.

### **Theory**

#### **Unit – I: BASICS OF HORTICULTURE**

Horticulture - Its definition and branches, importance and scope; horticultural and botanical classification, climate and soil for horticultural crops.

#### **Unit - II: PROPAGATION AND USE OF GROWTH REGULATORS**

Plant propagation-methods and propagating structures; Seed dormancy, Seed germination and importance of plant bio regulators in horticulture

#### **Unit – III: ORCHARD ESTABLISHMENT**

Principles of orchard establishment, orchard layout and planting systems in horticulture.

#### **Unit – IV: ORCHARD MANAGEMENT**

Principles and methods of training and pruning, irrigation methods, role of fertilizers and their application in horticultural crops.

#### **Unit – V: UNFRUITFULNESS AND PARTHENO-CARPY**

Unfruitfulness – causes and remedies, pollination, pollinizers and pollinators, fertilization and parthenocarpy, medicinal and aromatic plants.

## Practical

Identification of garden tools. Identification of horticultural crops. Preparation of seed bed / nursery bed. Practice of sexual and asexual methods of propagation including micro-propagation. Layout and planting of orchard. Training and pruning of fruit trees. Preparation of potting mixture. Fertilizer application in different crops. Visits to commercial nurseries/orchard.

## Lecture Schedule

1. Definition, importance, scope of Horticulture
2. Divisions of Horticulture and horticultural and botanical classification of crops
3. Importance and role of soil and climate in horticultural crop production
4. Definition, importance and methods of plant propagation in horticultural crops
5. Specialised plant propagation structures in horticultural crops
6. Seed development, germination and dormancy
7. Principles of orchard layout and planting systems for fruit crops
8. Principles and methods of training in horticultural crops
9. **MID SEMESTER EXAMINATION**
10. Principles and methods of pruning in horticultural crops
11. Problem of unfruitfulness and their remedy in horticultural crops
12. Parthenocarpy in fruits and vegetables
13. Importance and application of plant growth regulators in horticultural crops
14. Definition, importance and methods of irrigation in horticultural crops
15. Role of manures and fertilizers and their method of application in horticultural crops
16. Medicinal and aromatic plants and their importance

## Practical schedule

1. Study of various features in orchard
2. Identification of various horticultural crops in the orchard
3. Study of horticultural tools and implements
4. Studies on media for horticultural plants and preparation of potting mixture
5. Studies on seed treatment methods in horticultural crops
6. Preparation and use of growth regulators in horticultural crops
7. Preparation of nursery beds and portrayal raising of horticultural plants
8. Propagation through cutting and layering of horticultural crops
9. Propagation through grafting and budding of horticultural crops
10. Studies on micro propagation in horticultural crops
11. Layout of kitchen garden / nutrition garden
12. Studies on planting system and planting of horticultural crops
13. Studies on training and pruning in horticulture
14. Studies on irrigation methods in horticulture with special reference to micro irrigation
15. Practicing various methods of fertilizer application in horticultural crops
16. Visit to commercial nurseries / orchard
17. **PRACTICAL EXAMINATION**

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## SAC 101 Fundamentals of Soil Science (2 + 1)

### Outcomes:

- Understanding the origin of earth, rocks and minerals, soil genesis and soil taxonomy.
- Understanding soil physical properties, soil chemical, soil biological properties, and soil survey and soil pollution.

### 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.

### **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

### References

1. Brady, N.C., 2002 The Nature and Properties of Soils (13<sup>th</sup> 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, New Delhi
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.
5. Biswas T.D. and Mukherjee S.K., 1987. Text Book of Soil Science–Tata McGraw Hill Publishing Co. Ltd., New Delhi.
6. Jenny, H. 1941. Factors of Soil Formation - A System of Quantitative Pedology. McGraw-Hill Book Company INC. New York.
7. Joffe, J.S. 1936. The ABC of Soils. Pedology Publication, New Jersey.

### Web resources

- 1...[http://www.sciencedirect.com/science?\\_ob=ArticleURL&\\_udi=B6V67-4C837XP\\_user=2945072&\\_coverDate=01/31/2005&\\_rdoc=1&\\_fmt=high&\\_orig](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](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](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](http://wfrec.ifas.ufl.edu/landscape_horticulture/PDFdocuments/SoilProp.pdf)
6. [http://www.rootsofpeace.org/assets/Soil%20Testing%20Manual%20V6%20\(Feb%208\).pdf](http://www.rootsofpeace.org/assets/Soil%20Testing%20Manual%20V6%20(Feb%208).pdf)
7. <http://www.soils.wisc.edu/courses/SS325/morphology.htm>

## MAT 101 Elementary Mathematics (0+1)

### Outcomes:

- Understanding the concepts of matrices, determinants, analytical geometry and differential calculus.
- Skill to apply mathematical models in Agricultural systems.

### 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 of  $x^n$ ,  $e^x$ ,  $\sin x$  &  $\cos x$  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 by substitution 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 mathematical models- 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 3<sup>rd</sup> 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  $(x_1, y_1)$  &  $(x_2, y_2)$ .

#### 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 substitution method.
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.**

#### **References:**

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

### **NSS 101 NATIONAL SERVICE SCHEME (0+1)**

#### **Outcomes:**

- Understanding organizational set up of NSS at Central, State University and college levels
- Understanding NSS programme planning and implementation, awareness campaign, campus development activities and NSS special camp of villages.

#### **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. **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. Conducting seminar / workshop in a nearby village to motivate the youth on agribusiness (involving DEE, 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, manufacture 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 like Convocation, Farmers day, Sports meet and other University / College functions. NSS Volunteers will attend one special camp in the selected village for a duration of 7 days and undertake various activities based on the need of that village. For all out door regular activities villages / slums nearby the campus may be selected to avoid transport cost (cycle able distance) Special camp activity will be conducted in a village situated within a radius of 15 – 20 KM.

**Outcomes**

- Understanding principles of NCC, NCC system of training, Arms drill, Guard of honour and Ceremonial Drill
- Skill in weapon training, First-Aid, self Defence mechanisms, adventure training and camps.

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	<b>Final Examination</b>

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 and Yoga Practices (0+1)**

#### **Outcomes**

- Understanding importance of exercises for strength, agility, co-ordination, flexibility and endurance
- Skill development in games
- Learning different asana and yoga practices.

#### **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, overhead pass, setting, spiking, back pass, jump pass, stunts, elementary 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, wall practice, spin service and defence tactics.

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

**Hockey** : Grip, bully, dribbling, hitting, drive, push strokes, scoop, flick, stopping, various types of passes, dodging, defence and offence tactics.

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

**Chess** : Moves, move of king, move of pawns, move of rooks, move of bishops, move of queen, move of knights, 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 pary obaine, discopot, 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 any one of the games and athletic events.

Aims and objectives of yoga – asanas : ie. padmasana, pujanakasana, sarvangasana, chakrasana, dhanurasana, halasana, mayurasana and savasana, asanas for ailments, back pain, arthritis, abdominal problems, stress, fatigue, Insomnia, obesity, circulation, hypertension, varicose veins, respiration, heart, digestion, 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.

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## SEMESTER II

Sl.No.	Course No.	Course Title	Cr.Hr.
1.	AEC 101	Fundamentals of Agricultural Economics	2+0
2.	AEN 101	Fundamentals of Entomology	2+1
3.	AEX 102	Fundamentals of Agricultural Extension Education	2+1
4.	AGR 102	Introductory Agro-meteorology & Climate Change	1+1
5.	BIC 101	Fundamentals of Biochemistry	1+1
6.	COM 101	Agri- Informatics	1+1
7.	ENS 101	Environmental Studies and Disaster Management	2+1
8.	FOR 101	Introduction to Forestry	1+1
9.	PAT 101	Fundamentals of Plant Pathology	2+1
	NSS 101 / NCC 101	National Social Service / National Cadet Corps*	0+1
	PED 101	Physical Education & Yoga Practices*	0+1
TOTAL			14+8=22

\*Non-Gradual Course continued from first semester

## **AEC 101 Fundamentals of Agricultural Economics (2+0)**

### **Outcomes**

- In depth understanding of concepts of economics, theory of consumption, production, exchange and distribution.
- Understanding the macro economic concepts.

### **Theory**

#### **Unit:1 Nature and Scope of Economics**

Economics: Meaning, scope and subject matter, definitions, activities, approaches to economic analysis; micro and macroeconomics, positive and normative analysis. Nature of economic theory; rationality assumption, concept of equilibrium, economic laws as generalization of human behavior. Basic concepts: Goods and services, desire, want, demand, utility, cost and price, wealth, capital, income and welfare. Agricultural economics: meaning, definition, characteristics of agriculture, importance and its role in economic development. Agricultural planning and development in the country.

#### **Unit:2 Theory of Consumption**

Demand: meaning, law of demand, schedule and demand curve, determinants, utility theory; law of diminishing marginal utility, equi-marginal utility principle. Indifference curve analysis and properties, budget line - Consumer's equilibrium and derivation of demand curve, concept of consumer surplus. Elasticity of demand: concept and measurement of price elasticity, income elasticity and cross elasticity.

#### **Unit:3 Theory of Production**

Production: process, creation of utility, factors of production, input output relationship. Laws of returns: Law of variable proportions and law of returns to scale. Cost: concepts, short run and long run cost curves. Supply: Stock v/s supply, law of supply, schedule, supply curve, determinants of supply, elasticity of supply.

#### **Unit:4 Exchange and Theory of Distribution**

Market structure: meaning and types of market, basic features of perfectly competitive and imperfect markets. Price determination under perfect competition; short run and long run equilibrium of firm and industry, shut down and break even points. Distribution theory: meaning, factor market and pricing of factors of production. Concepts of rent, wage, interest and profit.

#### **Unit:5 Macroeconomic Concepts**

National income: Meaning and importance, circular flow, concepts of national income accounting and approaches to measurement, difficulties in measurement. Population: Importance, Malthusian and Optimum population theories, natural and socio-economic determinants, current policies and programmes on population control. Money: Barter system of exchange and its problems, evolution, meaning and functions of money, classification of money, supply, general price index, inflation and deflation. Banking: Role in modern economy, types of banks, functions of commercial and central bank, credit creation

policy. Agricultural and public finance: meaning, micro v/s macro finance, need for agricultural finance, public revenue and public expenditure. Tax: meaning, direct and indirect taxes, agricultural taxation, VAT/GST. Economic systems: Concepts of economy and its functions, important features of capitalistic, socialistic and mixed economies, elements of economic planning. Planning commission/ NitiAayog.

### **Lecture schedule**

1. Economics: Meaning, scope and subject matter, definitions – Wealth, welfare, scarcity and growth definitions.
2. Approaches to economic analysis; micro and macroeconomics, positive and normative analysis – deductive and inductive methods.
3. Nature of economic theory; rationality assumption, concept of equilibrium, economic laws as generalization of human behaviour – Basic concepts: Goods and services – classification and characteristics.
4. Want – meaning and characteristics, demand, utility, cost and price, wealth, capital, income and welfare.
5. Agricultural economics: meaning, definition, characteristics of agriculture, importance and its role in economic development.
6. Agricultural planning and development in the country.
7. Utility theory - cardinal and ordinal utility; law of diminishing marginal utility, equi-marginal utility principle: definition, assumptions – limitations and applications.
8. Demand: meaning, kinds of demand, law of demand, demand schedule and demand curve, determinants of demand – Extension and contraction Vs Increase and decrease in demand.
9. Indifference curve analysis and properties – budget line – definition, assumptions, limitations and applications – Consumer's equilibrium and derivation of demand curve.
10. Engel's Law of Family Expenditure – Consumers surplus: definition and importance.
11. Elasticity of demand: concept and measurement of price elasticity, income elasticity and cross elasticity – Factors influencing elasticity of demand – Importance of elasticity of demand.
12. Production: process, creation of utility, factors of production, definition and characteristics - Input Output Relationship.
13. Laws of returns: Law of variable proportions and law of returns to scale.
14. Cost: Cost concepts, short run and long run cost curves.
15. Supply: Stock versus supply, law of supply, supply schedule, supply curve, Supply and its determinants of supply, elasticity of supply.
16. Market structure: meaning and types of market, basic features of perfectly competitive and imperfect markets.
17. **Mid Semester Examination**
18. Price determination under perfect competition; short run and long run equilibrium of firm and industry, shut down and break even points.
19. Distribution theory: meaning, factor market and pricing of factors of production.
20. Concepts of Rent and Ricardian theory of rent - Quasi rent - Wages: Real wage and money wage
21. Interest: Pure interest and gross interest –Profit: Meaning of economic profit.

22. National income: Meaning and importance, circular flow, Concepts of national income - accounting and approaches to measurement, difficulties in measurement.
23. Population: Importance, Malthusian and Optimum population theories
24. Natural and socio-economic determinants, current policies and programmes on population control.
25. Money: Barter system of exchange and its problems, evolution, meaning and functions of money.
26. Classification of money, money supply, general price index, inflation and deflation, inflation – meaning, definition, types of inflation – Welfare economics – meaning – Pareto optimality – SDG.
27. Banking: Role in modern economy, types of banks, functions of commercial and central bank, credit creation policy.
28. Agricultural and public finance: meaning, micro versus macro finance, need for agricultural finance, public revenue and public expenditure.
29. Tax: meaning, direct and indirect taxes, Canons of taxation - agricultural taxation, VAT and GST.
30. Economic systems: Concepts of economy and its functions,
31. Important features of capitalistic, socialistic and mixed economies.
32. Economic planning: its importance, elements of economic planning. Planning commission/ NitiAayog.

## References

1. Dewett, K.K. 2002. Modern Economic Theory, Syamlal Charitable Trust, New Delhi.
2. Samuelson, P. 2004. Economics, (18/e), Tata McGraw-Hill, New Delhi
3. Koutsoyiannis, A. 1983. Modern Microeconomics, The Macmillan Press Ltd., Hongkong
4. Varian, H.R. 1987. Intermediate Microeconomics, W.W. Norton & Company, New Delhi
5. Seth, M.L. 2000. Principles of Economics, Lakshmi Narain Agarwal Co., Agra. New Delhi

## E-References:

1. [www.paiancoa.ac.in](http://www.paiancoa.ac.in)
2. [www.tawn.tnau.ac.in](http://www.tawn.tnau.ac.in)
3. [www.usbr.gov/pn/agri.met](http://www.usbr.gov/pn/agri.met)

## AEN 101 FUNDAMENTALS OF ENTOMOLOGY (2+1)

### Outcomes:

- Understanding the position of insects in animal kingdom, insect morphology, anatomy and physiology.
- Understanding taxonomy of insects.

## 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.

## **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. Psocoptera, 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, Belostomatidae, 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, Sphecidae, Vespidae, Formicidae , Xylocopidae, Chalcididae, Megachilidae, Ichneumonidae, Bethyidae, Braconidae, Agaonidae, Evaniidae, Encyrtidae, Eulophidae and Trichogrammatidae).
14. Observing the characters of Coleoptera (Curculionidae, Apionidae, Cicindellidae, Carabidae, Staphylinidae, Dytiscidae, Coccinellidae, Gyrinidae, Lampyriidae, Hydrophilidae, Scarabaeidae, Dynastidae, 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, Cochliidiidae, Geometridae, Gelechiidae, Pterophoridae, Saturniidae, Sphingidae, Lymantriidae and Hesperidae)
16. Observing the characters of Neuroptera (Chrysopidae, Myrmeleonidae, Mantispidae, Ascalaphidae), Siphonoptera. Identification and naming of collected insects based on characters — order and family
17. **Practical examination**

## References

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, Cornell University 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.

## **AEX 102 FUNDAMENTALS OF AGRICULTURAL EXTENSION EDUCATION (2+1)**

### **Outcomes:**

- Understanding extension education, programme planning, rural development, extension teaching methods.
- Understanding extension administration and recent approaches in Agricultural extension.

### **Theory**

#### **Unit I: Extension Education, Programme Planning**

Education: Meaning, definition & Types; Extension Education- meaning, definition, scope and process; objectives and principles of Extension Education; Extension Programme planning-Meaning, Process, Principles and Steps in Programme Development.

#### **Unit II : Evolution of Extension System, Rural development**

Rural Development: concept, meaning, definition. Extension systems in India: extension efforts in pre-independence era (Sriniketan, Marthandam, Firka Development Scheme, Gurgaon Experiment, etc.) and post-independence era (Etawah Pilot Project, Nilokheri Experiment, etc.); Community Dev.-meaning, definition, concept & principles, Philosophy of C.D. and NES and Panchayat raj. Various extension/ agriculture development programmes launched by ICAR/ Govt. of India (IADP, IAAP, HYVP, KVK, IVLP, ORP, ND, NATP, NAIP, etc.). Various agricultural/ rural development programmes launched by Govt. of India – ATMA, PKVY, PMKSY.

#### **Unit III: Extension Teaching Methods**

Transfer of technology: concept and models T& V, BBES, Extension Teaching Methods: meaning, classification, individual, group and mass contact methods. Extension Communication: meaning and importance. Agricultural journalism, Diffusion and Adoption of innovation: concept and meaning, process and stages of adoption, adopter categories.

#### **Unit IV : Extension administration and Rural Leaders**

Extension administration: meaning and concept, principles and functions. Capacity building of extension personnel, Monitoring and Evaluation: concept and definition, monitoring and evaluation of extension programmes. Rural Leadership: concept and definition, types, selection and training of leaders in rural context.

## **Unit V : Recent approaches in Agricultural Extension**

New trends in agriculture extension: privatization extension, cyber extension/ e-extension, market-led extension, farmer-led extension, expert systems, etc. ICT Applications in TOT (New and Social Media), media mix strategies.

### **Lecture Schedule**

1. Education: Meaning, definition & Types;
2. Extension Education: meaning, definition, scope and process;
3. Extension Education : objectives and principles of Extension Education.
4. Extension programme planning: Meaning, Process, Principles.
5. Steps in programme planning and importance of programme planning.
6. Monitoring and evaluation: concept and definition, monitoring and evaluation of extension programmes.
7. Rural Development: concept, meaning, definition. - Extension systems in India: extension efforts in pre-independence era (Sriniketan, Marthandam, Firka Development Scheme, Gurgaon Experiment, IVS, Economic Conference of Mysore etc.,)
8. Extension systems in India post-independence era (Etawah Pilot Project, Nilokheri Experiment, etc.)
9. Community Development : meaning, definition, concept & principles, Philosophy of C.D and NES
10. Extension/ agriculture development programmes launched by ICAR/ Govt. of India (IADP, IAAP, HYVP, KVK, ATIC etc.,)
11. Extension/ agriculture development programmes launched by ICAR/ Govt. of India - IVLP, ORP, ND,NATP, NAIP).
12. Various agricultural/ rural development programmes launched by Govt. of India – ATMA, PKVY, PMKSY.
13. Panchayatraj - Meaning of Democratic – Decentralization and Panchayat Raj, Three tiers of Panchayat Raj system, Functions and Organizational setup.
14. Rural Leadership: concept, definition and types of leaders.
15. Selection and training of lay leaders in rural context.
16. Transfer of technology: concept, models T & V, BBES
17. **Mid Semester**
18. Extension teaching methods: meaning, classification.
19. Individual contact methods - farm and home visit, result demonstration and field trails – meaning, objectives, steps
20. Group contact methods - Method demonstration, Group discussion sessions, field trips - meaning, objectives, steps.
21. Mass contact methods : campaign, exhibition, farmers day Radio, TV - purpose, procedures, advantages and limitations.
22. Extension Communication: meaning and definition and Importance
23. Agricultural journalism
24. Diffusion and adoption of innovation: concept and meaning, process.
25. Concept of innovation, attributes of innovation and Elements of diffusion. Difference between communication and diffusion.
26. Adoption process, models of adoption process, steps in adoption process.

27. Innovation-decision process, functions, adopter categories-factors influencing adoption
28. Extension administration: meaning and concept, principles and functions.
29. Capacity building of extension personnel – Training and types of training
30. New trends in agriculture extension: Privatization of extension, market-led extension, and farmer-led extension.
31. New trends in agriculture extension: cyber extension, e- extension, expert systems.
32. ICT Applications in TOT (New and Social Media), media mix strategies, Kissan Call Centres, mobile apps.

## **Practical**

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

## **Practical Schedule**

1. Understanding about the University extension system.
2. Visit to Department of Agriculture and allied departments.
3. Understanding the functioning of BDO/DRDA
4. Visit to NGO
5. Presentation about the understanding of extension system of various development departments.
6. Preparation of Leaflet, Folder, Booklet, pamphlet - I
7. Preparation of Leaflet, Folder, Booklet, pamphlet - II
8. Writing news stories and success stories
9. Handling of digital camera and LCD projector
10. Script writing for radio and Television/video
11. Presentation of radio and Television/video script.
12. Visit to Community radio centre/AIR
13. Visit to Educational Media Centre
14. Presentation skills exercise - micro teaching exercise
15. Understanding about PRA
16. Visit to village to understand the problems being encountered by the farmers by practicing selected PRA techniques.
17. Practical Exam

## References

1. Ray, G.L., 1999. Extension Communication and Management, Naya Prokash, 206, Bidhan Sarani, Calcutta.
2. Rogers, E.M. 1995. Diffusion of Innovations, The Free Press, New York
3. Sandhu, A.S. 1996. Extension Programme Planning, Oxford & IBH Publishing Co. pvt. Ltd, New Delhi
4. Sandhu, A.S. 1996. Agricultural Communication: Process and Methods, Oxford & IBH Publishing Co. Pvt. Ltd, New Delhi.

## Journals

1. Indian Journal of Social Sciences, Serials Publications, New Delhi
2. Agricultural Extension Review, Department of Agriculture and Co-operation, Ministry of Agriculture, New Delhi
3. Journal of Rural Development, NIRD, Rajendra Nagar, Hyderabad
4. MANAGE, NAARM, Hyderabad
5. Yojana, Ministry of Rural Development, New Delhi

## Web resources

1. [www.i4d.com](http://www.i4d.com)
2. [www.panasia.org](http://www.panasia.org)
3. [www.joe.org](http://www.joe.org)

## AGR 102 INTRODUCTORY AGRO METEOROLOGY & CLIMATE CHANGE (1+1)

### Outcomes:

- Understanding the concepts of meteorology, importance in crop production, different agricultural seasons of India and Tamilnadu.
- Understanding the role of solar radiation, temperature, Rtt, atmospheric pressure and wind in crop production.
- Understanding weather forecasting and climate change.

### Theory:

#### Unit I: Climate and weather

Meteorology - Agricultural Meteorology - Importance and scope in crop production - Co-ordinates of India and Tamil Nadu – Earth Atmosphere - Composition and vertical layers of atmosphere (stratification) – Atmospheric variables - Climate - Weather - Factors affecting climate and weather - Different agricultural seasons of India and Tamil Nadu.

#### Unit II: Solar radiation, Temperature and RH

Nature and properties of solar radiation, Light intensity, quality, direction and duration solar constant, depletion of solar radiation, short wave, long wave and thermal radiation, net radiation, albedo; Energy balance of Earth. Air and Soil temperature – Diurnal and seasonal variation - importance in crop production. Heat unit and its importance in agriculture. Relative Humidity and its importance - vapor pressure deficit and its importance

### **Unit III: Atmospheric pressure and Wind**

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

### **Unit IV: Precipitation and weather hazards**

Precipitation - forms - monsoon – mechanism- importance in Indian Agriculture- rainfall variability – Weather hazards-drought, flood and their effect – extreme weather conditions such as heat wave- cold wave-Cloud seeding - Evaporation - transpiration - Evapotranspiration - PET.

### **Unit V: Weather forecasting and Climate change**

Agro climatic normals - Weather forecasting – types-uses and its impact in agriculture. Climate change- climate variability, global warming - definition and causes of climate change - Impact of climate change on Regional and national Agriculture.

### **Practical:**

Visit of Agro meteorological Observatory, site selection of observatory, exposure of instruments and weather data recording. Measurement of total, shortwave and long wave radiation, and its estimation using Planck's intensity law. Measurement of albedo and sunshine duration, computation of Radiation Intensity using BSS. Measurement of maximum and minimum air temperatures, its tabulation, trend and variation analysis. Measurement of soil temperature and computation of soil heat flux. Determination of vapor pressure and relative humidity. Determination of dew point temperature. Measurement of atmospheric pressure and analysis of atmospheric conditions. Measurement of wind speed and wind direction, preparation of wind rose. Measurement, tabulation and analysis of rain. Measurement of open pan evaporation and Evapotranspiration. Computation of PET and AET, Agro climatic zones of India & TamilNadu.

### **Lecture Schedule:**

1. Meteorology - Agricultural Meteorology - Definition, their importance and scope in crop production. Coordinates of India and Tamil Nadu.
2. Atmosphere - Composition of atmosphere - Vertical layers of atmosphere based on temperature difference / lapse rate.
3. Climate and weather - Factors affecting climate and weather. Macroclimate - Meso climate - Microclimate - Definition.
4. Nature and properties of Solar radiation – Energy balance - Wave length characteristics and their effect on crop production - Light - effect of intensity, quality- albedo, direction and duration on crop production.
5. Air temperature - Factors affecting temperature. Diurnal and seasonal variation in air temperature - Isotherm, Heat unit and its use - Heat and cold injuries.
6. Role of temperature in crop production. – Lapse rate- inversion daily and seasonal variation in temperature-Soil temperature - Importance in crop production.

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

#### **Practical Schedule:**

1. Visit to Agrometeorological observatory- Site selection and layout for Agromet Observatory.
2. Calculation of local time - Time of observation of different weather elements - Reviewing agromet registers.
3. Measurement of total, shortwave and long wave radiation and use of plank's law for radiation estimation.
4. Measurements of albedo- sunshine hours (sunshine recorder)
5. Measurement of maximum and minimum air temperatures-tabulation-analysis.
6. Measurement of soil temperature and grass minimum thermometers – soil heat flux.
7. Relative humidity measurements - use of wet and dry bulb thermometers –
8. Psychrometer- Hygrograph-Determination of vapour pressure determination- dew point temperature.
9. Measurement of atmospheric pressure - barograph - Fortin's barometer – analysis of atmospheric conditions.
10. Measurement of wind direction and wind speed and conversion (KMPH, KNOT, and M/Sec.) – wind roses.
11. Measurement of rainfall - Ordinary and self-recording rain gauges
12. Measurement of Dew - dew gauge
13. Probability analysis of rainfall for crop planning.
14. Measurement of Evaporation - Open pan evaporimeter- application of evaporation data.
15. Computation of ET-AET- PET.
16. Mapping of agro climatic Zones of India and Tamil Nadu and its characterization.
17. **PRACTICAL EXAMINATION.**

### References:

1. Gopalaswamy, N. 1994. Agricultural Meteorology, Rawat publications, Jaipur.
2. Mavi, H.S., 1996. Introduction to Agro meteorology, oxford and IBH publishing Co., New Delhi.
3. Prasad, Reddy, S.R. and Reddy, D.S. 2014. Agro meteorology. Kalyani Publishers, NewDelhi
4. Murthy, R.V. 2002. Basic Principles of Agricultural Meteorology. BS Publications, Hyderabad.
5. Narayanan.AL.2015.Principles of Applied Agricultural Meteorology, Sri Velan Pathipagam, Chidambaram.
6. Rao, G.S.L.H.V. 2005. Agricultural Meteorology. Kerala Agricultural University Press, Thrissur.
7. Rao, P.2008. Agricultural Meteorology. Prentice Hall of India Pvt. Ltd, NewDelhi
8. Reddy, S.R. 2014. Introduction to Agriculture and Agro meteorology. Kalyani Publishers, NewDelhi. Patra, A.K. 2016. Principles and applications of Agricultural Meteorology. New India Publishing Agency, New Delhi.
9. Singh, J. 2014. Textbook of Agricultural meteorology. Oxford Book Company, New Delhi.
10. Smith, J.W. 2013. Agricultural meteorology. Axis Books (India), Jodhpur
11. Yellamanda Reddy, T. and G.H. Sankara Reddi, 2004. Principles of Agronomy, Kalyani Publishers, Ludhiana.

### E-References:

1. [www.pajancoa.ac.in](http://www.pajancoa.ac.in)
2. [www.tawn.tnau.ac.in](http://www.tawn.tnau.ac.in)
3. [www.usbr.gov/pn/agri.met](http://www.usbr.gov/pn/agri.met)
4. [www.imd.gov.in](http://www.imd.gov.in)

## BIC 101 Fundamentals of Biochemistry (1+1)

### Outcomes:

- Understanding concepts of biochemistry, carbohydrates, lipids, proteins, enzymes and nucleic acids.
- Skills in estimation of starch, amylose, amino acids, protein and ascorbic acid.

### 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. **Allosteric enzymes.**

### **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/ Mono saccharides.

### **Theory Lecture schedule:**

1. Introduction to Biochemistry, Carbohydrates – occurrence and classification
2. Structure of mono saccharides, 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**

#### References:

1. Berg JM, Tymoczko JL and Stryer L, (2007), Biochemistry, 7<sup>th</sup> 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, New Delhi.
5. Sadasivam, S and Manickam, A. 1996. Biochemical methods for Agricultural sciences. New age International publishers, New Delhi.

#### E-References:

1. Cox, MM and Nelson, DL. (2011), Principles of Biochemistry, Fourth (Indian edition) Macmillan, Worth Publishers. <http://bcs.whfreeman.com/lehninger6e> - Web links/ Tutorials/ Lecture companion Art.
2. Harper's illustrated Biochemistry -<https://freemededebooks.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, 3<sup>rd</sup> Edn, New Age International.
5. Wilson, K. and Walker, J.M. (2000), Principles and techniques of Practical Biochemistry, 5<sup>th</sup> Edn. – Cambridge University Press.
6. [www.ncbi.nlm.nih.gov](http://www.ncbi.nlm.nih.gov)

## COM 101 Agri-Informatics (1+1)

### Outcomes:

- In-depth understanding of various concepts of programming using python
- Skill to do statistical analysis using 'R'
- Understanding role of information communication technology (ICT) in Agriculture.

### Theory

#### Unit I: Introduction to Computers

Hardware, Software, Block diagram of a computer, RAM, Hard disks, Input / Output devices. Trash, Copy, Move, Rename, & Delete File/Folder using Linux File Manager Files / Nautilus

#### Unit II: Introduction to LibreOffice

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.

LibreOffice Base - Creating Table in Design View

LibreOffice Base - Create using Wizard - Queries, Forms, and Reports

#### Unit III: Introduction to Programming using Python

input, print, if, elif, else using Python

list, for in list using Python

#### Unit IV: Statistical Analysis using R

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

#### Unit V: e-Agriculture (ICT in Agriculture)

ICT in Agriculture, Internet, World Wide Web, Browsers, Email.

Computer controlled devices (automated systems) for Agriculture,

Smartphone Apps for Agriculture, E-Commerce for Agriculture,

Global Positioning System (GPS) for Agriculture,

Geographic Information Systems (GIS) for Agriculture,

Introduction to Crop Simulation Model

### Theory Lecture Schedule

1. Hardware, Software, Block diagram of a computer, RAM, Hard disks, Input / Output devices.

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. LibreOffice Base - Creating Table in Design View
8. LibreOffice Base - Create using Wizard - Queries, Forms, and Reports

### **9. Mid-Semester Exam**

10. input, print, if, elif, else using Python
11. list, for in list using Python
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. ICT in Agriculture, Internet, World Wide Web, Browsers, Email.  
Computer controlled devices (automated systems) for Agriculture,  
Smartphone Apps for Agriculture, E-Commerce for Agriculture,  
Global Positioning System (GPS) for Agriculture,  
Geographic Information Systems (GIS) for Agriculture,  
Introduction to Crop Simulation Model

### **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, 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, LibreOffice Base – Table creation in design view, Create using Wizard - Queries, Forms, and Reports, Python Programming – input, print, if, elif, else, list, for in list, R Console, R Prompt > , Using R - 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, Hands on a Crop Simulation Model Software.

### **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. LibreOffice Base – Table creation in design view
8. LibreOffice Base – Create using Wizard - Queries, Forms, and Reports
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. Hands on a Crop Simulation Model Software
17. Practical Examination

## 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](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/>

## ENS 101 Environmental Studies and Disaster Management (2+1)

### Outcomes:

- Understanding the concepts and importance of various natural resources, ecosystem and biodiversity.
- Understanding environmental pollution, laws and regulations.

### 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-spots of biodiversity. Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts. Endangered and endemic species of India. Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity.

### **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.

## 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**

## References:

1. Erach Bharucha, Text book for Environmental studies. University Grants Commission, New Delhi
2. Tyler Miller and Scot Spoolman. 2009. Living in the Environment (*Concepts, Connections, and Solutions*). Brooks/cole, Cengage learning publication, Belmont, USA
3. P.D. Sharma, 2009, Ecology and Environment, Rastogi Publications, Meerat, India.
4. De. A.K., 2010. Environmental chemistry. Published by New Age International Publishers, New Delhi. ISBN:13–978 81 224 2617 5. 384 pp.
5. Diwan, P. and P. Diwan. 1998. *Environmental Management Law and Administration*. Variety Books International, New Delhi.
6. William, P. Cuning Ham and Mary Ann. Inquiry and applications Cunningham 2005. Principles of Environmental science. Tata MCG raw-hill publishing company limited, New Delhi.

## E-References:

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

**FOR 101**

**INTRODUCTION TO FORESTRY**

**1+1**

## Outcomes

- Understanding the role of forestry, silvics and silviculture, agroforestry and social forestry.
- Understanding forest utilization and silviculture techniques.

## Theory

### Unit-I: Forest and Forestry, Silvics and Silviculture

Indian Forest - Status of Indian forests – Global forest scenario- History of forest- Role of forests – Locality Factors- Regeneration techniques- Natural Regeneration- Artificial Regeneration- Quality planting stock production techniques- Clonal forestry techniques

### Unit-II: Agroforestry and its classification

Agroforestry – Definition- Benefits and constraints in agroforestry –Classification of agroforestry systems – Agroforestry systems for seven agro climatic zones of Tamil Nadu. Role of trees in soil fertility- Difference between agroforestry and social forestry

### Unit-III: Social forestry

Social forestry – History – Concepts – Objectives – components – Social forestry projects in Tamil Nadu – targets and achievements. Community forestry - Interface forestry – Joint forest management (JFM) – Tamil Nadu Afforestation Project (TAP)- Urban forestry- Recreation forestry- Ecotourism- Concepts and its application



#### **Unit-IV: Forest Utilization**

Forest utilization- Solid wood- timber and its products- Non Timber forest products – Non wood forest produce- status and value addition

#### **Unit-V: Silviculture techniques**

Silviculture of Teak, Eucalyptus, Casuarina, Ailanthus, sandal wood, Red sander, Neem, *Melia dubia*, Pungam, Tamarind, *Acacia* spp, Silk cotton and Bamboos.

#### **PRACTICAL**

Forest nursery technology – Types of forest nurseries – Layout – Bed preparation – Identification of seeds and seedlings of multipurpose trees – Nursery practices for teak, sandal, rose wood, eucalyptus, Casuarina, Bamboo, Acacia, TBO – Clonal propagation techniques for forest trees- Study of pulp and paper making- Study of ply wood production technology- study of match manufacturing process- practicing tree planting technique- Practicing tending and cultural operation – Visit to forest nursery – Visit to agroforestry model unit- Visit to pulp and paper manufacturing industry- Visit to plywood industry- Visit to matchwood industry- Visit to NWFP value addition unit

#### **Theory Schedule**

1. Forest definition - Indian forest- History of forest- Global Scenario- Classification of forest Role of forests – productive role –protective role.
2. Locality Factors (Climate, edaphic, physiographic and biotic factors) - Regeneration techniques- Natural Regeneration
3. Artificial Regeneration- Quality planting stock production techniques- Clonal forestry techniques
4. Agroforestry-definition- different terminologies- concepts- Classification of agroforestry systems on structural, functional, socio- economic and ecological basis
5. Primary systems - agrisilviculture, silvipasture, agrisilvipasture and mixed woodlots. Sub-systems - shifting cultivation, taungya, home garden, intercropping, alley cropping, multistorey cropping, windbreak and shelterbelt - Constraints in agroforestry – interference effects - management options for overcoming constraints - diagnosis and design methodology.
6. Distinction between agroforestry and social forestry- Benefits and constraints of agroforestry- Agroforestry systems for seven agro climatic zones of Tamil Nadu. Role of trees in soil fertility
7. Social forestry- History – Concepts – Objectives - Social forestry in Tamil Nadu, Interface forestry – JFM
8. Social forestry projects in Tamil Nadu – Phase I & II– sponsoring agency - components, targets and achievements. Social forestry projects in Tamil Nadu - TAP and NAP projects
9. **MID SEMESTER EXAMINATION**
10. Urban forestry, recreation forestry techniques -Ecotourism- concepts and its application
11. Forest utilization- Solid wood- timber and its products
12. Forest utilization - Non Timber forest products (fibers, flosses, grasses, bamboos and canes- status and value addition
13. Silviculture techniques for Teak, Eucalyptus and Casuarina

14. Silviculture techniques for Neem, Melia, Pungam
15. Silviculture techniques for Ailanthus, Sandal wood and Red sander
16. Silviculture techniques for Silk cotton, Acacias and Bamboos

#### **PRACTICAL SCHEDULE**

1. A study on forest nursery technology and seed treatment process for tree species
2. Identification of seeds and seedlings of important multipurpose tree species
3. Nursery practices for teak and sandal wood
4. Nursery practices for Eucalyptus and casuarinas
5. Nursery practices for Neem and Melia
6. Nursery practices for pungam and prosopis
7. Nursery practices for Red sander and Silk cotton
8. Nursery practices for *Acacia* spp
9. Nursery management and propagation techniques in bamboos
10. Clonal propagation techniques for forest trees
11. Practicing tree planting technique
12. Practicing tending and cultural operations in forest plantations
13. Visit to forest nursery and agroforestry model unit
14. Study on pulp and paper manufacturing and visit to pulp and paper manufacturing industry
15. Study on plywood manufacturing and visit to plywood industry
16. Study on matchwood manufacturing and visit to matchwood industry

#### **17. FINAL PRACTICAL EXAMINATION**

#### **References**

1. Avey, M.E., M.G.R. Cannel and C. Ong. 1991. Biophysical research for Asian agroforestry. Winrock International, USA & South Asia Books, USA. 292 p.
2. Bentley, W.R., P.K. Khosla and K. Secler. 1993. Agroforestry in South Asia – Problems and applied research perspectives. Oxford & IBH Publishing Co., New Delhi. 390 p.
3. Burch, W.R. and J.K. Parker. 1992. Social science applications in Asian agroforestry. Winrock International, USA & South Asia Books, USA. 187 p.
4. Dwivedi, A.P. 1992. Principles and Practices of Indian Silviculture. Surya publications, Dehradun. 469p
5. Gupta, R.K. 1993. Multipurpose Trees for Agroforestry and Wasteland Utilization. Oxford and IBH Publishing company, New Delhi. 580p
6. Nair, P.K.R. 1993. Introduction to agroforestry. Kluwer Academic Publishers, Dordrecht, Netherlands. 499p
7. Negi, S.S. 1986. A Hand book of Social Forestry. International Book Distributors, Dehradun. 177p
8. Prasad, V.N. 1985. Principles of Social cum Community Forestry International Book Distributors, Dehradun. 108p

**Outcomes:**

- In-depth understanding of concepts, classification of plant diseases, pathogenesis.
- Understanding symptoms of fungal, bacterial and virus disease of plants.

**Theory****Unit I: Introduction to Plant Pathology**

Importance of plant diseases- Plant Pathology – Definition – Scope and objectives of Plant Pathology - History of Plant Pathology - Causes and classification of plant diseases - Etiology of plant diseases - Biotic and abiotic - Plant Pathogenic organisms – Protozoa, Fungi, Bacteria, *Candidatus* Phytoplasma, Fastidious Vascular Bacteria, *Spiroplasma*, Virus, Viroids, Algae and Phanerogamic parasites – Abiotic disorders

**Unit II: Pathogenesis**

Koch's postulates - Pathogenesis - Mode of infection – Pre-penetration, penetration and post penetration - Types of parasitism - Spread and survival of plant pathogens -Role of enzymes and toxins in disease development

**Unit III: General characters and taxonomy of *Protozoa*, *Chromista* and *Fungi***

General characters of fungi – somatic structures, types of fungal mycelia - Resting structures - Asexual and sexual reproduction in fungi - Fruiting bodies - Physiological specialization in fungi - Symptoms of fungal diseases - Taxonomy and Classification of fungi based on Ainsworth and Bisby's dictionary of fungi 10<sup>th</sup> edition - General characters and symptoms of Kingdom: *Protozoa* - Phylum: *Plasmodiophoromycota*, *Plasmodiophora brassicae* - Kingdom: *Chromista* - Phylum: *Oomycota* - *Pythium*, *Albugo*, *Phytophthora*, *Sclerospora* and *Plasmopara* - Kingdom: *Fungi* - Phylum: *Chytridiomycota* - *Synchytrium* - Phylum: *Zygomycota* – *Mucor* and *Rhizopus*

**Unit IV: General characters and taxonomy of fungi - *Ascomycota* and *Basidiomycota***

Phylum: *Ascomycota*: Classification, symptoms and taxonomy characters of *Taphrina*, *Capnodium*, *Cercospora*, (*Mycosphaerella*), *Cochliobolus* (*Helminthosporium*), *Alternaria* (*Lewia*), *Venturia*, *Macrophomina*, *Botryodiplodia* (*Botryosphaeria*), *Aspergillus* (*Eurotium*), *Penicillium* (*Talaromyces*), *Erysiphe*, *Leveillula*, *Phyllactinia*, *Claviceps*, *Ustilaginoidea*, *Fusarium* (*Gibberella*), *Verticillium*, *Colletotrichum* (*Glomerella*) *Pestalotia* (*Pestalosphaeria*) and *Pyricularia* (*Magnaporthe*) - Phylum: *Basidiomycota*: Classification, symptoms and life cycle of *Puccinia*, *Uromyces*, *Hemileia*, *Ustilago* and *Exobasidium* - Important taxonomic characters of *Agaricus*, *Pleurotus*, *Volvariella* and *Calocybe* - Symptoms and Important taxonomic characters of *Ganoderma*, *Sclerotium* (*Athelium*) and *Thanetophorus* (*Rhizoctonia*).

**Unit V: Bacteria, virus, viroids, algae, phanerogamic parasite and abiotic disorders**

Classification of bacteria - General characters and symptoms of phytopathogenic bacteria - Pathogenesis - Mode of entry, survival and spread - General characters and symptoms of *Candidatus* Phytoplasma, Fastidious Vascular Bacteria, *Spiroplasma*, Virus, Viroids, Algae Phanerogamic parasites and abiotic disorders.

## 1. Practical

Acquaintance with microscopes - Preparation of media and study of Koch's postulates - General characters of fungi - Types of mycelia -Types of vegetative, asexual and sexual spores - Asexual and sexual fruiting bodies - Study of important taxonomic characters and symptoms produced by *Plasmodiophora*, *Pythium*, *Albugo*, *Phytophthora*, *Sclerospora*, *Plasmopara*, *Mucor*, *Rhizopus*, *Taphrina*, *Cercospora*, (*Mycosphaerella*), *Helminthosporium* (*Cochliobolus*), *Alternaria* (*Lewia*), *Venturia*, *Macrophomina*, *Botryodiplodia* (*Botryosphaeria*), *Aspergillus* (*Eurotium*), *Penicillium* (*Talaromyces*), *Erysiphe*, *Leveillula*, *Phyllactinia*, *Claviceps*, *Ustilaginoidea*, *Fusarium* (*Gibberella*), *Verticillium*, *Colletotrichum* (*Glomerella*) *Pestalotia* (*Pestalosphaeria*), *Pyricularia* (*Magnaporthe*), *Puccinia*, *Uromyces*, *Hemileia*, *Ustilago*, *Sphacelotheca* (*Sporisorium*), *Tolyposporium* (*Moesziomyces*), *Exobasidium*, *Ganoderma*, *Sclerotium* (*Athelium*) and *Thanetophorus* (*Rhizoctonia*)- Important taxonomic characters of *Agaricus*, *Pleurotus*, *Volvariella* and *Calocybe* - Symptoms caused by bacteria, *Candidatus* Phytoplasma, fastidious vascular bacteria, algal parasite, phanerogamic parasites and non-parasitic diseases.

**Note:** Students should submit 50 well preserved diseased specimens in 3 installments during the semester.

## 2. Theory schedule

1. Plant diseases – Concepts and history of Plant Pathology
2. Etiology - Classification of plant diseases - Koch's Postulate
3. Infectious and non - infectious diseases - Biotic agents- Fungi, bacteria, *Candidatus* Phytoplasma, fastidious vascular bacteria, spiroplasma, virus, viroids, algae and phanerogamic parasites- Abiotic disorders
4. Types of parasitism –parasite, saprophyte, facultative saprophyte, facultative parasite, obligate parasite, biotrophs, hemibiotrophs, perthotrophs, necrotrophs, and symbiosis
5. Pathogenesis – Stages in pathogenesis
6. Spread and survival of fungal pathogens
7. Role of enzymes and toxins in pathogenesis
8. General characters of fungi- Types of Mycelia – Resting structures
9. Asexual and sexual reproduction in fungi
10. Physiological specialization in fungi
11. Classification of Kingdom - *Protozoa* –*Fungi like Protozoa* - General characters - Life cycle and symptoms produced by *Plasmodiophora brassicae* – *Flagellate Protozoa* - Taxonomic characters and diseases caused by *Phytomonas*
12. Classification of Kingdom : *Chromista* - General characters – Phylum: *Oomycota* – General characters and classification
13. Taxonomic characters, life cycle and symptoms produced by *Pythium*, *Albugo* and *Phytophthora*
14. Taxonomic characters and symptoms produced by downy mildew fungi - Life cycle of *Sclerospora* and *Plasmopara*
15. Classification of Kingdom: *Fungi* – Phylum: *Chytridiomycota* and *Zygomycota* - Taxonomic characters, life cycle and symptoms produced by *Rhizopus* and *Mucor*
16. Classification of Phylum: *Ascomycota*- General characters
17. **Mid Semester Examination**

18. Taxonomic characters and symptoms produced by *Taphrina*, *Capnodium*, *Cercospora*, (*Mycosphaerella*), *Helminthosporium* (*Cochliobolus*), *Alternaria* (*Lewia*), *Venturia*, *Macrophomina* and *Botryodiplodia* (*Botryosphaeria*)
19. Taxonomic characters and symptoms produced by *Aspergillus* (*Eurotium*), *Penicillium* (*Talaromyces*) and powdery mildew fungi – Life cycle of *Eurotium* and *Erysiphe*, *Uncinula*, *Leveillula* and *Phyllactinia*
20. Taxonomic characters and symptoms produced by *Claviceps*, *Ustilaginoidea*, *Fusarium* (*Gibberella*), *Verticillium*, *Colletotrichum* (*Glomerella*) *Pestalotia* (*Pestalospaeria*) and *Pyricularia* (*Magnoportha*)
21. Classification of Phylum: *Basidiomycota*- General characters
22. Symptoms and general characters of rust fungi - Life cycle of *Puccinia* and *Uromyces*
23. Symptoms and general characters of smut fungi - Life cycle of *Ustilago*
24. Taxonomic characters and symptoms produced by *Exobasidium*, *Ganoderma*, *Thanetophorus* (*Rhizoctonia*) and *Sclerotium* (*Athelium*) - Life cycle of *Thanetophorus*
25. Important taxonomic characters of *Agaricus*, *Pleurotus*, *Volvariella* and *Calocybe*
26. Classification and general characters of phytopathogenic bacteria
27. Mode of entry and symptoms produced by *Xanthomonas*, *Ralstonia*, *Erwinia*, *Pectobacterium*, *Agrobacterium* (*Rhizobium*), *Corynebacterium* (*Clavibacter*) and *Streptomyces*
28. General characters and symptoms produced by *Candidatus* Phytoplasma, Spiroplasma and fastidious vascular bacteria
29. Virus - Morphology, structure and multiplication of plant virus - Virusoids and Satellite RNA
30. Movement and transmission of plant viruses -Symptoms of virus diseases
31. Important characters and symptoms of Viroid, Algal and Phanerogamic parasites
32. Abiotic / non-parasitic diseases

### Practical schedule

1. Acquaintance with light microscope - and demonstration of Koch's postulates
2. Study of general characters of fungi - Types of mycelium and resting structures
3. Asexual and sexual reproduction in fungi
4. Study of systematic position, host parasite relationship and symptoms produced by *Plasmodiophora*, *Pythium* and *Albugo*.
5. Study of systematic position, host parasite relationship and symptoms produced by *Phytophthora*, *Sclerospora*, and *Plasmopara*
6. Study of systematic position, host parasite relationship and symptoms produced by *Rhizopus*, *Mucor*, *Taphrina* and *Capnodium*
7. Study of systematic position, host parasite relationship and symptoms produced by *Helminthosporium* (*Cochliobolus*), *Alternaria*, *Venturia*, *Macrophomina* and *Botryodiplodia* (*Botryosphaeria*)
8. Study of systematic position, host parasite relationship and symptoms produced by *Aspergillus* (*Eurotium*), *Penicillium* (*Talaromyces*), *Erysiphe*, *Leveillula* and *Phyllactinia*.
9. Study of systematic position, host parasite relationship and symptoms produced by *Claviceps*, *Fusarium* (*Gibberella*), *Verticillium*, *Colletotrichum* (*Glomerella*) *Pestalotia* (*Pestalospaeria*) and *Pyricularia* (*Magnoportha*)
10. Study of systematic position, host parasite relationship and symptoms produced by *Puccinia*, *Uromyces*, *Hemileia*, *Sphacelotheca* (*Sporisorium*) and *Tolyposporium* (*Moesziomyces*)

11. Study of systematic position, host parasite relationship and symptoms produced by *Exobasidium*, *Ganoderma*, *Sclerotium (Athelium)* and *Thanetophorus (Rhizoctonia)*.
12. Study of important taxonomic characters of *Agaricus*, *Pleurotus*, *Calocybe* and *Volvariella*
13. Symptoms Produced by bacteria, *Candidatus* Phytoplasma, Spiroplasma and fastidious vascular bacteria
14. Symptoms produced by virus and viroids
15. Symptoms produced by algae, phanerogamic parasites and non-parasitic diseases
16. Field visit

**Assignment:** Students should submit 50 well preserved diseased specimens in 3 installments during the semester.

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2. Alexopoulos, C.J., Mims, C.W. and Blackwell, M. 2010 Introductory Mycology. John Wiley and Sons Ltd., New York.
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7. Mandahar, C.L. 1987. Introduction to Plant Viruses, Chand and Co., Pvt. Ltd., New Delhi.
8. Hull, R. 2002. Mathews' Plant Virology (4th Edition), Academic Press Inc., London.
9. Janse J.D 2005 Phyto bacteriology- Principles and practice, CABI Publishing, UK

### Web resources

1. [www.mycobank.org](http://www.mycobank.org)
2. [www.mycology.net](http://www.mycology.net)
3. [www.bspp.org.uk](http://www.bspp.org.uk)
4. [www.ictv.org](http://www.ictv.org)
5. [www.bibo.library.cornell.edu](http://www.bibo.library.cornell.edu)
6. [www.apsnet.org](http://www.apsnet.org)

## Semester III

Sl.No.	Course No.	Course Title	Cr.Hr.
1.	AEC 201	Farm Management, Production & Resource Economics	1+1
2.	AEG 201	Farm Machinery and Power	1+1
3.	AEN 201	Principles of Integrated Pest Management	1+1
4.	AGR 201	Irrigation Management	1+1
5.	AMP 201	Livestock and Poultry Management	2+1
6.	ANM 201	Introductory Nematology	1+1
7.	GPB 201	Fundamentals of Plant Breeding	2+1
8.	HOR 211	Production Technology for Vegetables and Spices	1+1
9.	SAC 201	Problematic Soils and their Management	1+1
10.	SST 201	Principles of Seed Technology	2+1
11.	STA 201	Statistical Methods	1+1
	NSS 101 / NCC 101	National Social Service / National Cadet Corps*	0+1
	PED 101	Physical Education & Yoga Practices*	0+1
TOTAL			14+11=25

\*Non-Gradual Course continued from first semester

## **AEC 201 Farm Management, Production and Resource Economics (1+1)**

### **Outcomes:**

- Understanding the concepts of production economics and farm management.
- Understanding principles of Farm Management, Farm planning and budgeting, RISK & uncertainty in agricultural production and resource economics.

### **Theory**

#### **Unit 1: Production Economics and Farm Management - Nature and Scope**

Meaning and concept of farm management, objectives and relationship with other sciences. Meaning and definition of farms, its types and characteristics, factors determining types and size of farms. Types of farming: Specialized, Diversified, and Mixed farming – Systems of farming: Peasant Farming, State Farming, Capitalistic, Collective and Co – operative Farming.

#### **Unit 2: Factor – Product, Factor – Factor and Product – Product Relationships**

Principles of farm management: concept of production function and its characteristics and its type, use of production function in decision-making on a farm. Factor-Product relationship. Meaning, Definition – Laws of Returns. Meaning and concept of cost, types of costs, cost curves - and their inter-relationship - shut down and break-even points, importance of cost in managing farm business and estimation of gross farm income, net farm income, family labor income and farm business income. Economies of Scale – Economies of Size - Determination of Optimum Input and Output – Physical and Economic Optimum. Factor – Factor relationship: Least Cost Combination of inputs; Product – Product relationship: Optimum Combination of Products – Principle of Equi – Marginal Returns – Principle of Opportunity Cost and Minimum Loss Principle. Law of Comparative Advantage.

#### **Unit 3: Farm Planning and Budgeting**

Farm business analysis: meaning and concept of farm income and profitability, technical and economic efficiency measures in crop and livestock enterprises. Importance of farm records and accounts in managing a farm, various types of farm records needed to maintain on farm, farm inventory, balance sheet, profit and loss accounts. Meaning and importance of farm planning and budgeting, partial and complete budgeting, steps in farm planning and budgeting - linear programming, appraisal of farm resources, selection of crops and livestock's enterprises.

#### **Unit 4: Risk and Uncertainty in Agriculture Production**

Concept of risk and uncertainty occurrences in agriculture production, nature and sources of risks and their management strategies, Crop / livestock / machinery insurance. Weather based crop insurance - Features and determinants of compensations.

#### **Unit 5: Resource Economics**

Resource Economics: Concepts, Classification, differences between Natural Resource Economics (NRE) and agricultural economics, unique properties of natural resources. Natural Resources - Issues – Scarcity of resources – Factors mitigating scarcity – Property Rights: Common Property Resources (CPRs): meaning and characteristics of CPRs – Externalities:



meaning and types - positive and negative externalities in agriculture, Inefficiency and welfare loss, solutions; Important issues in economics and management of common property resources of land, water, pasture and forest resources.

### **Practical**

Preparation of farm layout. Determination of cost of fencing of a farm. Computation of depreciation cost of farm assets. Application of equi-marginal returns / opportunity cost principle in allocation of farm resources. Determination of most profitable level of inputs use in a farm production process. Determination of least cost combination of inputs. Selection of most profitable enterprise combination. Application of cost principles including CACP concepts in the estimation of cost of crops – Estimation of costs and returns of livestock products. Preparation of farm plan and budget, farm records and accounts and profit and loss accounts. Break – even analysis- Graphical solution to Linear Programming problem. Collection and analysis of data on various resources in India.

### **Theory lecture schedule**

1. Meaning and concept of farm management, objectives and relationship with other sciences. Meaning and definition of farms, its types and characteristics, factors determining types and size of farms – Objectives of farm management – Production Economics Vs Farm Management.
2. Types of farming: Specialized, Diversified, and Mixed farming – Systems of farming: Peasant Farming, State Farming, Capitalistic, Collective and Co – operative Farming.
3. Principles of farm management: Factor – Product relationship: Meaning, Definition – Laws of Returns: Concept of production function, Classical production function and three stages of production and its characteristics – types of production function and use of production function in decision making.
4. Meaning and concept of cost, types of costs, cost curves - and their inter-relationship -shut down and break even points, importance of cost in managing farm business and estimation of gross farm income, net farm income, family labour income and farm business income.
5. Economies of Scale – Economies of Size - Determination of Optimum Input and Output – Physical and Economic Optimum.
6. Factor – Factor relationship: Meaning – Isoquant – definition and types – isoquant map – MRTS – Isocost line - Least Cost Combination of inputs – expansion path – isocline – ridge line – Elasticity of Factor Substitution.
7. Product – Product relationship: Meaning – Production Possibility Curve – MRPT – Enterprise relationship: Joint products, complementary, supplementary and competitive products – Iso revenue line - Optimum Combination of Products.
8. Principle of Equi –Marginal Returns – Principle of Opportunity Cost and Minimum Loss Principle. Law of Comparative Advantage.
9. **Mid Semester Examination**
10. Farm business analysis: meaning and concept of farm income and profitability, technical and economic efficiency measures in crop and livestock enterprises.
11. Importance of farm records and accounts in managing a farm, various types of farm records needed to maintain on farm, farm inventory, balance sheet, profit and loss accounts.

12. Meaning and importance of farm planning and budgeting, partial and complete budgeting, steps in farm planning and budgeting – Concept of risk and uncertainty in agriculture production, nature and sources of risks and its management strategies.
13. Linear programming, appraisal of farm resources, selection of crop and livestock enterprises.
14. Crop / livestock / machinery insurance. Weather based crop insurance - Features and determinants of compensations.
15. Resource Economics: Concepts, Classification, differences between Natural Resource Economics (NRE) and agricultural economics, unique properties of natural resources.
16. Natural Resources Issues – Scarcity of resources – Factors mitigating scarcity – Property Rights – Common Property Resources (CPRs): meaning and characteristics of CPRs – Externalities: meaning and types - positive and negative externalities in agriculture – Inefficiency and welfare loss, solutions.
17. Important issues in economics and management of common property resources of land, water, pasture and forest resources.

### **Practical Schedule**

1. Preparation of farm layout. Determination of cost of fencing of a farm.
2. Computation of depreciation of farm assets. Cost of farm assets: Valuation of assets by different methods.
3. Application of equi - marginal returns / opportunity cost principle in allocation of farm resources.
4. Determination of most profitable level of inputs use in a farm production process.
5. Determination of least cost combination of inputs.
6. Selection of most profitable enterprise combination.
7. Application of cost principles including CACP concepts in the estimation of cost of cultivation and cost of production of agricultural crops.
8. Estimation of cost of cultivation and cost of production of perennial crops / horticultural crops.
9. Estimation of cost of returns of livestock products.
10. Preparation of farm plan and budget.
11. Farm records and accounts: Usefulness, types of farm records: farm production records and farm financial records.
12. Preparation of Cash flow statement
13. Preparation and Analysis of Net worth Statement and Profit and Loss statement
14. Estimation of Break – even analysis.
15. Graphical solution to Linear Programming problem.
16. Collection and analysis of data on various resources in India.
17. **Final Practical Examination.**

### **References**

1. Sankayan, P.L. 1983. Introduction to Farm Management. Tata McGraw Hill Publishing Company Ltd. New Delhi.
2. Johl, S.S & Kapoor, T.R. 1973. Fundamentals of Farm Business Management. Kalyani Publishers.Ludhiana.

3. Kahlon, A.S and Singh K. 1992. Economics of Farm Management in India. Allied Publishers. New Delhi.
4. Doll, J.P. and F. Orazem. 1983. Theory of Production Economics with Applications to Agriculture. John Wiley, New York.
5. Debertin, D.L. 1986. Agricultural Production Economics. Macmillan. New York.
6. Heady, E.O. and H.R. Jensen. 1954. Farm Management Economics. Prentice – Hall. Englewood Cliffs.
7. Kay, Ronald D., and William M. Edwards, and Patricia Duffy. 2004. Farm Management. Fifth Edition. McGraw–Hill Inc. New York.
8. Panda, S.C. 2007. Farm Management and Agricultural Marketing. Kalyani Publishers. Ludhiana. India.

#### **E-References:**

1. [www.pajancoa.ac.in](http://www.pajancoa.ac.in)
2. [www.tawn.tnau.ac.in](http://www.tawn.tnau.ac.in)
3. [www.usbr.gov/pn/agri.met](http://www.usbr.gov/pn/agri.met)

### **AEG 201      FARM MACHINERY AND POWER      1+1**

#### **Outcomes:**

- In-depth understanding of farm mechanization, sources of farm power, tractor and functional components.
- Understanding the usage of tillage, sowing, intercultural, plant protection and harvesting implements and equipment.

#### **Theory:**

##### **Unit I: Farm Power and IC engines**

Farm Power- Status of Farm Power in India and their use in agriculture, farm mechanization its advantages and limitations Sources of Farm Power, Engine – Types of engines; I.C. engines, working principles of IC engines, comparison of two stroke and four stroke cycle engines , Study of different components of IC engine, I.C. engine terminology and solved problems, Familiarization with different systems of I.C. engines: Air cleaning, cooling, lubrication, fuel supply.

##### **Unit II: Tractor and functional components**

Hydraulic control system of a tractor, Familiarization with Power transmission system: clutch, gear box, differential and final drive of a tractor, Tractor types, Cost analysis of tractor power and attached implements.

##### **Unit III: Tillage implements**

Familiarization with Primary and Secondary Tillage implements, Implements for hill agriculture.

#### **Unit IV: Sowing and Intercultural implements**

Familiarization with sowing and planting equipment, calibration of a seed drill and solved examples, implement for intercultural operations.

#### **Unit V: Plant Protection and Harvesting equipments**

Familiarization with Plant Protection equipments, Familiarization with harvesting and threshing equipments.

#### **Practical:**

Study of different components of I.C. engine - To study air cleaning and cooling system of engine - Familiarization with clutch - Transmission - Differential and final drive of a tractor - Familiarization with lubrication and fuel supply system of engine - Familiarization with brake - Steering - Hydraulic control system of engine - Learning of tractor driving - Familiarization with operation of power tiller - Implements for hill agriculture - Familiarization with different types of primary and secondary tillage implements - Mould board plough - Disc plough and disc harrow - Familiarization with seed-cum- fertilizer drills their seed metering mechanism and calibration - Planters and transplanter - Familiarization with different types of sprayers and dusters - Familiarization with different inter-cultivation equipment - Familiarization with harvesting and threshing machinery.

#### **Lecture schedule:**

1. Farm power - sources of farm power and their use in agriculture; farm mechanization its advantages and limitations; status of farm power in India.
2. Engine – Types of engines; components of IC engine - Working principles of IC Engines.
3. Two stroke and Four stroke engines – comparison - Engine terminology.
4. Familiarization of different systems of IC engine – air cleaning, cooling, lubricating and fuel supply systems.
5. Tractors – types; power transmission system - clutch, gearbox, differential and final drive and hydraulic system.
6. Cost analysis of tractor with attached implement.
7. Tillage – Definition, objectives and types; ploughing methods. Primary tillage implements - mould board plough, disc plough, chisel plough and subsoil plough - components and functions, types, advantages and disadvantages.
8. Secondary tillage equipments - cultivators, harrows, levelers; land forming equipments – rotovators, ridgers, bund former; puddlers - manure trammers and cage wheels,
9. **MID SEMESTER EXAMINATION**
10. Implements for Hill agriculture.
11. Sowing methods - seed drills and planters - seed cum fertilizer drills - components and functions - Calibration - solved examples.
12. Paddy transplanters - types, working principle, field and nursery requirements.
13. Implements for intercultural operations - cultivators, sweep, junior hoe, manual weeder and power operated weeder for wet land and garden land.
14. Sprayers and their functions, classification, manually operated sprayers, terminology, Nozzle types. Power operated sprayers - Tractor operated boom sprayer, Knapsack mist blower cum duster - Tall tree sprayer-dusters, types and uses.

15. Harvesting equipment - reapers - mowers and combine harvesters - types, construction and operation - Balers. Harvesting machinery for groundnut, tuber crops, cotton and sugarcane
16. Threshing of crop, thresher and its principles of operation - threshing losses.

**Practical schedule:**

1. Study of working of two and four stroke IC engines and their systems with solved problems.
2. Study of different systems of tractor - clutch, gearbox, differential and final drive, brake, steering, hydraulic control, air cleaning and cooling system, lubrication and fuel supply system of engine
3. Study of tractors and power tillers - their operation and maintenance.
4. Learning driving of tractor.
5. Learning operation of power tiller.
6. Study of primary tillage implements (mould board plough, disc plough, chisel plough and subsoiler) and their components.
7. Study of secondary tillage implements (cultivator, disc harrows, rotavator, bund former, ridger, leveller).
8. Study of seed drills, planters and seed-cum-fertilizer drills and their components and metering mechanisms - calibration- simple problems on calibration.
9. Study and operation of machinery for rice cultivation - puddling implements- rotary puddlers and cage wheels, tray seeder for rice nursery, transplanters - types operation and maintenance- drum seeder, conoweeder, power weeder and finger type weeder.
10. Study of different inter-cultivation equipment for uplands - manual, animal drawn, power operated - tractor and power tiller operated - field operation
11. Study of plant protection equipment – manually operated sprayers and dusters, knapsack mist blower cum duster, tractor operated sprayers- their operation, adjustment, calibration and safety requirements
12. Study of tools for hill agriculture and horticultural crops - propagation tools, vegetable transplanter, harvesting tools -lawn mower, posthole diggers, tree climber, shredders for crop residue.
13. Threshing machinery for paddy and identification of its components - different threshing drums - calculation of efficiency and losses.
14. Study of paddy reaper and paddy combine- their systems, method of operation and adjustment.
15. Study of harvesters for root crops - turmeric and tapioca and groundnut diggers
16. Problems on cost of operation of tractor operated machinery.
17. **FINAL PRACTICAL EXAMINATION.**

**References:**

1. JagadishwarSahay, 2010 - Elements of Agricultural Engineering. Standard Publishers Distributors, Delhi. ISBN 978-8180140440
2. Ojha, T. P. and Michael, A.M. Principles of Agricultural Engineering. Vol. I, Jain Brothers, 16/893, East Park Road, Karol Bagh, New Delhi -110005
3. S.C.Jain and C.R.Rai. Farm Tractor – Maintenance and Repair. Standard Publishers, 1705-B, NaiSarak, Delhi – 110006.

## **AEN 201 PRINCIPLES OF INTEGRATED PEST MANAGEMENT (1+1)**

### **Outcomes:**

- In-depth understanding of methods of diagnosis and detection of various insect pests, surveillance and forecasting of insect pests.
- Understanding assessment of crop yield losses, integrated pest management, safety issues in pesticide uses.

### **Theory**

#### **Unit –I: Pest categories and IPM**

Categories of insect pests, IPM: Introduction, history, importance, concepts, principles and tools of IPM. Economic importance of insect pests and pest risk analysis. Methods of detection and diagnosis of insect pests.

#### **Unit –II: Components of IPM**

Calculation and dynamics of economic injury level and importance of Economic threshold level. Methods of control: Host plant resistance, cultural, mechanical, physical, legislative, biological and chemical control.

#### **Unit –III: Ecology of pests**

Ecological management of crop environment. Introduction to conventional pesticides for the insect pests management. Survey surveillance and forecasting of insect pests.

#### **Unit –IV: IPM Module**

Development and validation of IPM module. Implementation and impact of IPM (IPM module for insect pests. Safety issues in pesticide uses.

#### **Unit –V: IPM case studies**

Political, social and legal implication of IPM. Case histories of important IPM programmes.

### **Practical**

Methods of diagnosis and detection of various insect pests, Methods of insect pests measurement, Assessment of crop yield losses, calculations based on economics of IPM, Identification of biocontrol agents, different predators and natural enemies. Mass multiplication of *Trichogramma*, NPV etc. Identification and nature of damage of important insect pests and their management. Crop (agro-ecosystem) dynamics of a selected insect pests. Plan and assess preventive strategies (IPM module) and decision making. Crop monitoring attacked by insect pests. Awareness campaign at farmers fields.

### **Lecture schedule**

1. Definition of insect ecology and introduction to environment and its components
2. Effect of abiotic factors- temp, moist, humidity, RF, light and air on the population of insects

3. Effect of biotic factors- food competition, natural and environmental resistance on the population of insects
4. Definition of pests, Categories of pests based on ETL and EIL
5. Causes for pest outbreak
6. Survey surveillance and forecasting of Insect pests
7. Definition and concept of IPM and scope and limitation of IPM
8. Tools of IPM and cultural methods of pest control

#### **9. Mid semester examination**

10. Mechanical methods of pests control
11. Physical methods of pests control
12. Biological control of insect pests and weeds
13. Legal methods of pest control
14. Host plant resistance in IPM
15. Chemical control- classification of insecticides
16. Case histories of important IPM programme.

#### **Practical schedule**

1. Types of damage caused by insect to plants
2. Methods of insect pests measurement and Assessment of crop yield losses
3. Pest survey, surveillance and forecasting
4. Different methods of insect sampling for insect population assessment
5. Identification of Predators
6. Identification of Parasitoids
7. Mass production of predators and parasitoids
8. Mass production of entomopathogens
9. Behavioural approaches in pest management
10. Pesticide formulation and application equipments
11. Different methods of pesticide application
12. Biotechnological approaches in pest management
13. Pest risk analysis and partial budgeting
14. Pest awareness campaign at farmers field (AESA)
15. IPM module for important pests
16. Identification of recent invasive pests

#### **17. Practical examination**

#### **References**

1. David, B.V and V.V.Ramamurthy. 2011. Elements of Economic Entomology. Namrutha Publications, Chennai.
2. Larry P. Pedigo. 2003. Entomology and pest management. Fourth edition, Pearson Education, Inc. Indian branch, 482. F.I.E. Patparganj, Delhi.
3. Dhaliwal G.S. and Ramesh Arora. 2009. Integrated pest management, Kalyani publisher, New Delhi
4. Atwal, A.S. and G.S. Dhaliwal. 2004. Agricultural Pests of South Asia and their management. Kalyani publisher, New Delhi.

**Outcomes:**

- Understanding irrigation systems of India, water resources and irrigation potential.
- Understanding soil-water-plant relationship, crop-water requirement, scheduling and methods of irrigation and quality of irrigation water and drainage.

**Theory:**

**Unit I: Irrigation- History and importance**

History and development of irrigation in India – Irrigation systems of India and Tamil Nadu – Importance of irrigation – Water resources and irrigation potential of India and Tamil Nadu - Role of water in plant growth

**Unit II: Soil-water-plant relationship**

Soil-plant-water relationship - Soil-plant atmospheric continuum – Hydrological cycle – Soil water movement – soil moisture constants - Absorption of water – Evapotranspiration – Moisture extraction pattern – 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 for different field crops.

**Unit IV: Scheduling and methods of irrigation**

Scheduling of irrigation – Different 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 – Water management for different field crops.

**Unit V: Quality of irrigation water and drainage**

Quality of irrigation water – Agronomic practices for use of poor quality water (saline, effluent and sewage water) for irrigation – tank irrigation, well irrigation – on-farm development – command area development - 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.



**Lecture schedule:**

1. History and development of irrigation in India - Irrigation systems of India and Tamil Nadu. Importance of irrigation
2. Water resources of India and Tamil Nadu - Role of water in plants
3. Soil – Plant –water relationship – soil physical characteristics (texture, structure, porosity, bulk density and particle density) in influencing irrigation. Soil-plant-atmospheric continuum - Hydrologic cycle.
4. Soil water movement – saturated, unsaturated flow and vapour movement - soil moisture constants and their importance in irrigation
5. Absorption of water and evapotranspiration - Available soil moisture – definition and importance – moisture extraction pattern -
6. Plant water stress – causes – plant response and adaptations – method to overcome plant water stress.
7. Crop water requirement – effective rainfall - potential evapotranspiration (PET), consumptive use (CU) – definition and estimation.
8. Factors affecting crop water requirement – Critical stages for irrigation – water requirement for different field crops.
9. **MIDSEMESTER EXAMINATION**
10. Scheduling of irrigation – criteria based on plant and soil moisture - different approaches - climatological approach, empirical methods, crop co-efficient.
11. Methods of irrigation – surface (flooding, beds and channels, border strip, ridges and furrows, broad bed and furrows, surge irrigation) and sub-surface methods.
12. Micro irrigation system (drip and sprinkler irrigation) – suitability, components, layout, operation, advantage and disadvantage.
13. Water use efficiency – definition and concept – methods to improve WUE – conjunctive use of water.
14. Water management for cereals, pulses, oilseeds and commercial crops (cotton, sugarcane, sugar beet, tobacco)
15. Quality of irrigation water – Agronomic practices for use of poor quality water (saline, effluent and sewage water) – Tank irrigation, well irrigation – on-farm development – Command area development.
16. Agricultural drainage – importance of drainage and different methods of drainage.

**Practical schedule:**

1. Determination of soil bulk density, particle density and porosity by different methods
2. Determination of soil moisture by direct methods
3. Determination of soil moisture by indirect methods
4. Determination of Soil moisture constants by different methods
5. Measurement of irrigation water
6. Determination of infiltration rate and hydraulic conductivity
7. Demonstration of Surface irrigation methods – I (Border Strip and Check Basin)
8. Demonstration of Surface irrigation methods – II (Ridges and Furrows and Broad bed furrow)
9. Layout, operation and maintenance of sprinkler irrigation systems
10. Layout, operation and maintenance of Drip irrigation systems

11. Scheduling of irrigation
12. Estimation of crop water requirement by direct and indirect methods
13. Calculations of irrigation water based on source, water flow, soil moisture status, depth of irrigation and efficiency parameters
14. Assessment of irrigation water quality parameters.
15. Visit to irrigation command area and study of command area development.
16. Observation on drainage structures during on / off campus field visit.
- 17. FINAL PRACTICAL EXAMINATION.**

#### **References:**

1. Lenka, D. 1999. Irrigation and Drainage. Kalyani Publishers.
2. Michael, A.M. 1997. Irrigation: Theory and Practice Vikas Publishers
3. Rao, Y.P and S.R.Bhaskar. 2008. Irrigation technology – theory and practice. Agrotech publishing company, Udhaipur.
4. Ramachandrappa, B.K and H.V.Nanjappa.2008. Fertigation technology. Agro-bios, Jodhpur.
5. Thokal, R.T., D.M. Mahale and A.G. Powar. 2004. Drip irrigation system-clogging and its prevention. Pointer publishers, Jaipur.
6. Prihar, S.S. and B.S. Sandhu. 1987. Irrigation to field crops: Principles and Practices. ICAR Publication.
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

### **AMP 201 LIVESTOCK AND POULTRY MANAGEMENT ( 2+1)**

#### **Outcomes:**

- In-depth understanding of significance of livestock and poultry in Indian economy, various system of livestock production.
- Understanding dairy cattle management, sheep and goat management, swine and poultry management.

#### **Theory:**

##### **Unit I: Introduction to Livestock and Poultry Management**

Significance of Livestock and Poultry in Indian Economy – Livestock and Poultry Census – Livestock Development Programmes of Government of India - Various systems of Livestock Production - Extensive - Semi intensive - Intensive - Mixed - Integrated and Specialized farms.

##### **Unit II: Dairy Cattle Management**

Breeds – Classification - Characteristics of Indian breeds - Sindhi, Gir, Sahiwal, Tharparkar, Kankeyam, Umblacherry. Exotic breeds - Jersey, Holstein Friesian. Buffalo breeds - Murrah and Surti. Breeding - Cross breeding - Upgrading - Economic traits of cattle - Culling -

Estrus Cycle – Artificial Insemination - Introduction to Embryo Transfer. Housing - Space requirement of young and adult stock - System and types of housing - Care and management of New born, Calf, Heifer, Pregnant and Milch animals. Nutrition - Balanced ration - Characteristics of ration - Classification of Feed and Fodder. Milk - Factors affecting milk composition - Pasteurization. Diseases - Classification - General Prevention and Control measures - Vaccination Schedule – Cause, symptoms and prevention of Viral disease - FMD - Bacterial - Anthrax, HS, BQ, Mastitis - Metabolic - Bloat, Ketosis and Milk Fever.

### **Unit III: Sheep and Goat Management**

Breeds – Classification - Economic traits - System of rearing - Housing Management - Floor space requirement - Care and Management of young and adult stock. Nutrition – Feeds and Fodders for Small Ruminants - Flushing - Diseases – Cause, symptoms and prevention of FMD, Pox, Blue Tongue and Enterotoxaemia.

### **Unit IV: Swine Management**

Breeds – Economic traits - Housing - Nutrition - Creep feeding - Care and management of young and adult Stock. Diseases - Cause, symptoms and prevention of Swine fever, FMD, Erysipelas and Thumbs.

### **Unit V: Poultry Management**

Breeds - Commercial Strains of Broilers and Layers. Housing - Deep litter and cage system - Brooding - Litter management - Care and management of broilers and layers - Incubation and hatching of Eggs. Nutrition of Chick, Grower, Layer and Broilers. Diseases - Cause, Symptoms and Prevention of Viral diseases - Ranikhet, IBD, Bird Flu – Bacterial - E.coli, Coryza – Protozoan - Coccidiosis. Vaccination Schedule.

### **Practical:**

Study of external parts of Livestock. Identification of livestock and poultry - Tattooing-ear tags - wing and leg bands. Common restraining methods - Dehorning - Castration – Dentition. Type and design of livestock and poultry houses. Selection of dairy cows and work bullocks. Determination of specific gravity, fat percentage and total solids of milk - Common Adulterants and Preservatives of milk - Clean milk production and milking methods. Identification of feeds and fodder. Economics of Dairy, Goat and Swine farming. Study of external parts of Fowl - Preparation of Brooder House - Judging good layer and poor layer - Debeaking, delousing and deworming of poultry - Vaccination schedule for poultry - Demonstration of incubator and setter - Dressing of broiler chicken - Economics of Poultry Farming - Visit to a Dairy plant and Poultry farm.

### **Lecture Schedule:**

1. Significance of livestock and poultry in Indian economy - Livestock and poultry census. Different livestock development programmes of Government of India
2. Various systems of livestock production – extensive, semi intensive and intensive systems. Different Farming types - mixed, integrated and specialized farms.
3. Breeds - Classification of Indian white and black cattle - Breed characteristics of Sindhi, Gir, Sahiwal and Tharparkar.

4. Indian Draught breeds - Kangayam and Umblacherry. Exotic breeds - Jersey and Holstein Friesian - Indian Buffaloes - Murrah and Surti
5. Breeding - Cross breeding - Upgrading programme - Economic traits of cattle
6. Estrous cycle – Signs of Estrous - Artificial insemination - merits and demerits - Principles and outline of Embryo Transfer Technology
7. Housing - farm site selection - Floor space requirement for calves, heifer, milch animal and Work bullocks
8. Systems of housing - Single row system - Double row system - head to head and tail to tail -merits and demerits
9. Care and management of new born calf and heifers
10. Care and management of pregnant animals, lactating and dry cows.
11. Nutrition - Balanced ration - Desirable characteristics of a ration. Classification of feed stuffs - Concentrate and roughage – comparison
12. Model composition of concentrate mixture of young and adult stock - age wise feed and fodder requirement - Importance of green fodder.
13. Milk - factors affecting yield and composition – Pasteurization
14. Diseases - Classification - viral, bacterial and metabolic - General control and preventive measures - Vaccination schedule
15. Viral Disease - Foot and mouth - Bacterial disease - Anthrax, HS, BQ and Mastitis, Metabolic disease - Bloat, Ketosis and Milk fever.
16. Sheep and Goat farming - Classification of breeds of Indian and exotic origin - Nomenclature alone - Economic traits.
17. **MID SEMESTER EXAMINATION**
18. Systems of rearing - Housing management - Type and design - Space requirement for adult and young stock
19. Care and management of Ram, Ewe and Lamb - Nutrition - Feeds and Fodder for small ruminants.
20. Care and management of Buck, Doe and kid - Nutrition - Flushing.
21. Common diseases of sheep and goat – Sheep and Goat pox - Foot and Mouth - Blue tongue -Enterotoxaemia –Ecto and endo parasites.
22. Swine Husbandry – Common breeds of exotic origin - Nomenclature alone - Economic traits - Housing of Swine.
23. Care and management of Sow, Boar and piglets – Nutrition - Creep feeding.
24. Disease prevention and control of swine diseases – Swine Fever, FMD, Erysipelas, Thumbs, Ecto and endo parasites.
25. Poultry – Breed classification - Nomenclature of commercial layer and broiler strains
26. Systems of housing - Deep litter and Cage system - Floor space requirement - Common litter materials - litter management - merits and demerits.
27. Care and management of chicks - Brooder management.
28. Care and management of grower and layers - vaccination schedule.
29. Care and management of broilers - vaccination schedule.
30. Incubation and hatching of eggs.
31. Nutrition - Feed formulation - Composition of chick, grower, layer, broiler starter and finisher mashes - Feed Conversion Ratio of egg and meat.

32. Classification of Disease - Cause, symptoms and prevention of Viral disease - Ranikhet, IBD, Bird Flu - Bacterial disease - E.coli, Coryza - Protozoan disease - Coccidiosis

**Practical schedule:**

1. Study of external parts of Livestock
2. Identification of livestock and poultry
3. Common restraining methods of Livestock
4. Disbudding, Dehorning, Castration and Dentition of Livestock
5. Type & design of livestock and poultry houses
6. Selection of dairy cows and work bullocks
7. Determination of specific gravity, fat percentage and total solids of milk. Common adulterants and preservatives of milk
8. Clean milk production and Milking methods
9. Identification of feeds and fodder
10. Economics Dairy, Goat and Swine farming
11. Study of External Parts of Fowl. Preparation of Brooder House
12. Judging good layer and poor layer.
13. Debeaking, delousing and deworming of poultry - Vaccination schedule for poultry.
14. Demonstration of incubator and setter.
15. Demonstration of dressing of broiler chicken. Economics of Poultry Farming
16. Visit to a modern Dairy plant / poultry farms
- 17. Final Practical Examination**

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**Web resources:**

1. [www.sciencecentral.com](http://www.sciencecentral.com)
2. [www.ansci.umn.edu/poultry/resources/layermgmt.htm](http://www.ansci.umn.edu/poultry/resources/layermgmt.htm)
3. [www.armsd.com/](http://www.armsd.com/)
4. [www.animalwebsites.co.uk](http://www.animalwebsites.co.uk)
5. [www.intervet.com/species/pigs/websites.aspx](http://www.intervet.com/species/pigs/websites.aspx)
6. [www.britishangoragoats.org.uk/management.htm](http://www.britishangoragoats.org.uk/management.htm)
7. [www.indiagoatfarm.com](http://www.indiagoatfarm.com)
8. [www.indiadairy.com](http://www.indiadairy.com)
9. [www.indiagronet.com](http://www.indiagronet.com)
10. [www.foodsci.uoguelph.ca](http://www.foodsci.uoguelph.ca)

**ANM 201 INTRODUCTORY NEMATOLOGY (1+1)****Outcomes:**

- Understanding morphology and taxonomy of nematodes, symptoms of nematode damage, nematode management.
- Understanding nematode pests of crops.

**Theory****Unit I: Introduction - History and Importance of Nematodes:**

Introduction – Brief history and development of Nematology in India and abroad – Position of nematodes in animal kingdom – Economic importance of nematodes and loss in crop plants. Beneficial nematodes (entomopathogenic nematodes – *Steinernema* and *Heterorhabditis*).

**Unit II: Morphology and Taxonomy of Nematodes:**

Morphology and Anatomy of nematodes (cuticle, cephalic region, alimentary, excretory, reproductive and nervous system, sense organs) –Taxonomy of plant parasitic nematodes – Classification of plant parasitic nematodes based on feeding habits, temperature and mode of life.

**Unit III: Symptoms, interaction and bio-ecology of nematodes:**

Symptoms of nematode damage – Interaction of nematodes with other microorganisms (fungi, bacteria and viruses) – Biology and ecology of important plant parasitic nematodes. (*Meloidogyne*, *Heterodera*, *Rotylenchulus*, *Tylenchulus* and *Radopholus*).

**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; biological control (nematode trapping fungi, egg parasitic fungi, obligate parasites, PGPR and predators); chemical control – soil fumigants and nematode management. Integrated nematode management.

## **Unit V: Nematode pests of crops:**

Major nematode parasites and their management in cereals (rice and wheat), millets (sorghum and maize), pulses (redgram, blackgram, greengram and cowpea), oilseeds (castor and groundnut), fibre crops (cotton), vegetables (tomato, brinjal, bhendi, chilli and potato), fruits (banana, citrus, grapevine and papaya), spices and plantation crops (turmeric, pepper, betelvine and coconut), flower crops (crossandra, jasmine and tuberose) and medicinal and aromatic plants, (medicinal coleus, dioscorea, geranium and patchouli).

### **Practical:**

Methods of survey – sampling methods, collection of soil and plant samples; Extraction of nematodes from soil and plant tissues following combined Cobb's decanting-sieving and Baermann funnel technique and Modified Baermann funnel Technique, counting and estimation of plant parasitic nematodes; Extraction of nematodes by sugar flotation technique; Extraction of cyst nematodes from soil by Fenwick can and other methods. Preparation of temporary and permanent mounts; Morphology of orders Tylenchida (*Hoplolaimus*), and Dorylaimida (*Xiphinema*) Study and identification of most important plant parasitic nematodes with special – *Meloidogyne*, *Pratylenchus*, *Hirschmanniella*, *Heterodera*, *Globodera*, *Tylenchulus*, *Radopholus*, *Rotylenchulus*, and *Helicotylenchus*. Study of life stages of *Meloidogyne*, *Rotylenchulus* and *Radopholus*. Study of different types of nematicides, application methods and calculation of dosages.

### **Lecture schedule**

#### **Theory**

1. Introduction – Brief history and development of Nematology in India and abroad
2. Position of nematodes in animal kingdom – Economic importance of nematodes and loss in crop plants. Beneficial nematodes.
3. Nematode Morphology - Cuticle, cephalic region.
4. Nematode Anatomy - alimentary, excretory, nervous system.
5. Nematode anatomy - sense organs, reproductive system.
6. Taxonomy of plant parasitic nematodes- Secernentea and Adenophorea
7. Classification of plant parasitic nematodes based on feeding habits, temperature and mode of life.
8. Symptoms of nematode damage.

#### **9. Mid-semester examination**

10. Interaction of nematodes with other microorganisms (fungi, bacteria and viruses)
11. Biology and ecology of important plant parasitic nematodes, (*Meloidogyne*, *Heterodera*, *Rotylenchulus*, *Tylenchulus* and *Radopholus*).
12. Principles of nematode management – Legislative, Physical, Cultural, host plant resistance to nematodes, biological, chemical. Integrated nematode management.
13. Nematode parasites of cereals, millets and pulses
14. Nematode parasites of oilseeds and fibre crops
15. Nematode parasites of vegetables and fruits.
16. Nematode parasites of spices, plantation, flower, medicinal and aromatic plants.

**Practical:**

1. Methods of survey – sampling methods, collection of soil and plant samples. Extraction of nematodes by Cobb's decanting–sieving method and Baermann funnel technique and Modified Baermann funnel Technique. Counting and estimation of plant parasitic nematodes.
2. Extraction of nematodes by sugar flotation technique
3. Extraction of cyst nematodes by Fenwick can and other methods.
4. Extraction of nematodes from plant roots and staining of roots infested with endo and semi-endoparasitic nematodes.
5. Killing, fixing of nematodes and preservation of nematodes and preparation of temporary and permanent mounts.
6. Morphology of orders Tylenchida (*Hoplolaimus*) and Dorylaimida (*Xiphinema* and *Longidorus*)
7. Identification of nematodes *Tylenchorhynchus* and *Helicotylenchus*
8. Identification of nematodes *Pratylenchus* and *Hirschmanniella*
9. Identification of nematodes *Hemicriconemoides* and *Criconema*; *Heterodera* and *Globodera*
10. Identification of nematodes *Tylenchulus* and *Aphelenchoides*
11. Study of life stages of *Meloidogyne*.
12. Study of life stages of *Rotylenchulus*
13. Study of life stages of *Radopholus*.
14. Nematode disease of rice: white tip and rice root nematode
15. Nematode damage symptoms caused by citrus nematode, lesion nematode and burrowing nematode.
16. Study of different nematicides, application methods and calculation of nematicide dosages.
17. **Practical examination.**

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

**Further reading:**

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2. Bhatti, D.S. and R.K.Walia. 1992. Nematode pests of crops, CBS Publishers and Distributors, 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](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/>



## **GPB 201 Fundamentals of Plant Breeding (2+1)**

### **Outcomes:**

- In-depth understanding of reproductive systems in plant breeding, breeding methods of self-pollinated, cross pollinated and clonally propagated crops.
- Understanding special breeding methods, Varietal Release, Maintenance Breeding, Markers and IPR.

### **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, Zhukovsky – law of homologous series. Plant genetic resources – importance – germplasm – types – activities – gene erosion - gene bank – collection - conservation – types of conservation. Germplasm: evaluation – use of descriptors, documentation, utilization; Agencies – national and international; germplasm exchange – quarantine. Modes of reproduction – sexual – asexual – mechanisms promoting self and cross pollination – significance of pollination. Self incompatibility – classifications – mechanisms – application – measures to overcome and limitations. Sterility – male sterility – introduction – classification – CMS, GMS, CGMS -inheritance and applications. EGMS - TGMS, PGMS, Gametocides, Transgenic Male sterility and applications. Apomixis – introduction – classification - applications; Parthenocarpy and its types. Polygenic variation-components of variance - phenotypic, genotypic and environmental variance-heritability and genetic advance-combining ability-gene action-mating designs.

#### **Unit 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, Zhukovsky – 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 - Johansen'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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**HOR 211**

**PRODUCTION TECHNOLOGY FOR VEGETABLES AND SPICES**

**1+1**

## Outcomes:

- Understanding production technology for vegetables like tomato and brinjal, okra, cucurbits, cole crops, peas and beans.
- Learning production technology for spices like black pepper, cardamom, ginger and turmeric.

## Theory

### Unit – I: Introduction and production technology for tomato and brinjal

Importance of vegetables and spices- kitchen gardening - origin, area, climate, soil, improved varieties and cultivation practices such as time of sowing, transplanting techniques, planting distance, fertilizer requirements, irrigation, weed management, harvesting and yield, physiological disorders of tomato and Brinjal.

### Unit – II: Production technology for okra, cucurbits, cole crops, peas and beans

Origin, area, climate, soil, improved varieties and cultivation practices such as time of sowing, transplanting techniques, planting distance, fertilizer requirements, irrigation, weed management, harvesting and yield, physiological disorders of okra, cucurbits (cucumber, melons, gourds and pumpkin) , cole crops (Cauliflower, Cabbage and Knol khol), peas and French bean.

### **Unit – III: Production technology for root crops, tubers and bulbs**

Origin, area, climate, soil, improved varieties and cultivation practices such as time of sowing, transplanting techniques, planting distance, fertilizer requirements, irrigation, weed management, harvesting and yield, physiological disorders of root crops (Radish, Carrot and Beet root), bulb crops (Onion and Garlic) and tuber crops (Potato and Tapioca).

### **Unit – IV: Production technology and processing of black pepper, cardamom, ginger and turmeric**

Origin, area, climate, soil, improved varieties and cultivation practices such as propagation, planting, shade regulation, training and pruning, fertilizer requirements, irrigation, inter cultural operations, harvesting, processing and yield- pest and diseases of black pepper, cardamom, ginger and turmeric.

### **Unit – V: Production technology for coriander, fenugreek, cumin and fennel**

Origin, area, climate, soil, improved varieties and cultivation practices such as propagation, planting, shade regulation, training and pruning, fertilizer requirements, irrigation, inter cultural operations, harvesting , processing and yield- pest and diseases of seed spices (coriander, fenugreek, cumin and fennel).

### **Practical**

Identification of vegetables & spice crops and their seeds. Nursery raising. Direct seed sowing and transplanting. Study of morphological characters of different vegetables & spices. Fertilizers applications. Harvesting & preparation for market. Economics of vegetables and spices cultivation.

### **Lecture Schedule**

1. Importance of vegetable and species –kitchen garden
2. Tomato-, origin, area, climate, soil, improved varieties and cultivation practices such as time of sowing, transplanting techniques, planting distance, fertilizer requirements, irrigation, weed management, harvesting and yield, physiological disorders
3. Brinjal and Chilli-origin, area, production, varieties and - origin, area, climate, soil, improved varieties and cultivation practices such as time of sowing, transplanting techniques, planting distance, fertilizer requirements, irrigation, weed management, harvesting and yield, physiological disorders
4. Okra and Leafy vegetables (Amaranthus, palak and perennial vegetables) - origin, area, climate, soil, improved varieties and cultivation practices such as time of sowing, transplanting techniques, planting distance, fertilizer requirements, irrigation, weed management, harvesting and yield, physiological disorders
5. Cucurbits-(cucumber, melons, gourds and pumpkin) - Sex expression- origin, area, climate, soil, improved varieties and cultivation practices such as time of sowing, transplanting techniques, planting distance, fertilizer requirements, irrigation, weed management, harvesting and yield, physiological disorders
6. Cauliflower, Cabbage and Knol khol- origin, area, climate, soil, improved varieties and cultivation practices such as time of sowing, transplanting techniques, planting distance,

fertilizer requirements, irrigation, weed management, harvesting and yield, physiological disorders

7. Peas and French bean- origin, area, climate, soil, improved varieties and cultivation practices such as time of sowing, transplanting techniques, planting distance, fertilizer requirements, irrigation, weed management, harvesting and yield, physiological disorders
8. Root crops(Radish, Carrot and Beet root)- - origin, area, climate, soil, improved varieties and cultivation practices such as time of sowing, transplanting techniques, planting distance, fertilizer requirements, irrigation, weed management, harvesting and yield, physiological disorders
9. **MID SEMESTER EXAMINATION**
10. Bulb crops (Onion and Garlic)- origin, area, climate, soil, improved varieties and cultivation practices such as time of sowing, transplanting techniques, planting distance, fertilizer requirements, irrigation, weed management, harvesting and yield, physiological disorders
11. Tuber crops (Potato and Tapioca)- origin, area, climate, soil, improved varieties and cultivation practices such as time of sowing, transplanting techniques, planting distance, fertilizer requirements, irrigation, weed management, harvesting and yield, physiological disorders
12. Black pepper- origin, area, climate, soil, improved varieties and cultivation practices such as propagation, planting, shade regulation, training and pruning, fertilizer requirements, irrigation, inter cultural operations, harvesting , processing and yield- pest and diseases.
13. Cardamom - origin, area, climate, soil, improved varieties and cultivation practices such as propagation, planting, shade regulation, training and pruning, fertilizer requirements, irrigation, inter cultural operations, harvesting , processing and yield- pest and diseases.
14. Clove and Cinnamom- - origin, area, climate, soil, improved varieties and cultivation practices such as propagation, planting, shade regulation, training and pruning, fertilizer requirements, irrigation, inter cultural operations, harvesting , processing and yield- pest and diseases
15. Ginger, Turmeric and coriander - origin, area, climate, soil, improved varieties, system of cultivation, propagation, planting, mulching, fertilizer requirements, irrigation, inter cropping, inter cultural operations, harvesting , processing and yield- pest and diseases
16. Cumin, Fennel and Fenugreek -origin, area, climate, soil, improved varieties and cultivation practices such as time of sowing, transplanting techniques, planting distance, fertilizer requirements, irrigation, weed management, harvesting ,processing and yield and physiological disorders

### **Practical Schedule**

1. Identification of vegetables and spices and their seeds
2. Nursery techniques for direct sowing / vegetative and transplanted vegetable crops
3. Study of morphological characters of tropical vegetables
4. Study of morphological characters of temperate vegetables
5. Method of fertilizer applications in different vegetable crops
6. Harvesting techniques in different vegetable crops
7. Post harvest handling of vegetable crops

8. Visit to commercial vegetable farms
9. Identification of different spices and their seeds
10. Method of propagation – Seed treatment and sowing / planting of different spices
11. Cultural operations – hoeing , earthing up, manuring and use of weedicides in spices
12. Training and pruning in tree spices
13. Maturity indices and harvesting of spices
14. Curing, processing and grading of spices
15. Economics of vegetable and spice cultivation
16. Visit to Commercial Spice garden
17. **PRACTICAL EXAMINATION**

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## **SAC 201 Problematic Soils and their Management (1+1)**

### **Outcomes:**

- In-depth understanding of Problem soil and soil quality, Physical and Chemical constraints & polluted soil
- Understanding remediation of solid and irrigation water.

### **Theory**

#### **Unit-I: Problem soil and soil quality**

Soil quality and health, Distribution of Waste land and problem soils in India. Categorization of waste lands based on properties. Problematic soils under different Agro ecosystems

#### **Unit-II: Chemical constraints**

Characteristics, reclamation and management of chemical constraints -, Saline and sodic soils, Acid soils, Acid Sulphate soils.

#### **Unit III: Physical constraints and polluted soil**

Soil physical constraints and management. Polluted soils and their management. Remote sensing and GIS in diagnosis and management of problem soils

#### **Unit-IV: Remediation of soils**

Multipurpose tree species, bio remediation of soils through MPTs. Land capability and suitability classification.

#### **Unit-IV: Irrigation water**

Irrigation water – quality and standards. Utilization of poor quality water in agriculture

### **Practical**

Identification, characterization and management of problem soils and water.

### **Lecture Schedule:**

1. Problem soils –Definition – Different types of problematic soils – Extent and distribution of problematic and wastelands soils in different agro-eco systems in India: coastal salinity, inland salinity, marshy, swampy soils, red sand dunes (Theri soils) Tsunami affected soils
2. Soil health and quality – Definition - Concepts – Soil resilience – Factors affecting soil quality (Physical, chemical and biological) – Assessment of soil quality - Management and improvement of soil quality
3. Saline soils – Visual symptoms for identification of saline soils – Build up of salinity -Effect of salinity on plant growth and nutrient availability - Reclamation and management.
4. Sodic soils - Visual symptoms for identification of sodic soils - Effect of sodicity on plant growth and nutrient availability - Reclamation and management.
5. Acid soils – Extent of area in India – Formation – Characteristics of acid soils – Sources of soil acidity – nutrient limitations and toxicity – Reclamation of acid soils - Different liming materials used for reclamation – Benefits of liming – Harmful effects of over liming.
6. Acid Sulphate soils – Origin – Types – Characterization - Constraints and management.

7. Land degradation - Eroded, compacted, flooded and water logged soils – Biologically sick soils – Effects on plant growth – Management.
8. Polluted soils – Definition – Sources of pollution – Bio solid wastes –Industrial effluents (distillery, paper mill, tannery, textiles industrial effluents) – Mechanism of interaction of wastes with soil.
9. Mid-semester examination
10. Soil pollution - Potentially toxic elements - Excessive use of fertilizers, pesticides and weedicides – Heavy metal contamination – Management..
11. Remote Sensing and GIS techniques in diagnosis, mapping and management of degraded and problematic soils.
12. Bio-remediation of problem soils through Multi Purpose Tree Species.
13. Taxonomic classification of soils - Land Capability Classification.
14. Land suitability classification - Index – Criteria - Different approaches – Land suitability for different crops
15. Irrigation water – Quality and standard parameters - Classification based on ICAR, CSSRI and USDA criteria.
16. Management of poor quality water in agriculture

#### **Practical schedule:**

1. Estimation of pH and EC of problem soil
2. Estimation of CEC of soil.
3. Estimation of exchangeable calcium and magnesium in soil.
4. Estimation of exchangeable sodium and potassium in soil. Categorization based on soil properties.
5. Estimation of lime requirement of acid soil
6. Estimation of Gypsum requirement of sodic soil.
7. Collection of different types of irrigation water samples and estimation of pH, EC and TSS.
8. Estimation of calcium and magnesium in irrigation water
9. Estimation of sodium and potassium in irrigation water
10. Estimation of carbonate and bicarbonate in irrigation water
11. Estimation of chloride and sulphate in irrigation water.
12. Estimation of Boron in irrigation water
13. Classification of irrigation waters as per USSL and other systems.
14. Computation of salts.
15. Estimation of heavy metals in polluted soil and water.
16. Interpretation of soil data for land capability and crop suitability.

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### SST 201 Principles of Seed Technology (2+1)

#### Outcomes:

- Understanding Principles of Seed Technology, Post-harvest handling of seeds, Seed quality enhancement techniques.
- Learning about seed certification, seed law enforcement, seed storage and marketing.

#### Theory

**Seed and seed technology-** definition -importance-Characters of good quality seed -Seed development and maturation - Germination - phases of seed germination - Dormancy - types of seed dormancy - Different classes of seed - generation system of seed multiplication in supply chain - Seed replacement rate and varietal replacement - Seed Multiplication Ratio -Seed renewal period. Varietal deterioration of crops - causes and maintenance. **Principles of seed production-** Foundation and certified seed production of varieties and hybrids - Cereals – rice, wheat, maize, sorghum and bajra - Pulses – green gram, black gram and red gram - Oilseeds - groundnut, sesame, sunflower and castor - Cotton, Forage crops - Cenchrus sp and lucerne - Vegetables - tomato, brinjal, chillies, bhendi, onion and gourds – bitter gourd, ash gourd, snake gourd, ribbed gourd, bottle gourd and pumpkin. Principles of GM crops and organic seed production.

**Post-harvest handling of seeds** - threshing methods - drying - methods of seed drying - Seed processing - seed cleaning and grading - Processing equipments - cleaner cum grader - Upgrading equipments - specific gravity separator, indented cylinder separator, spiral separator, magnetic separator, colour sorter, needle separator - working principles - **Seed quality enhancement techniques** - importance - seed fortification, seed priming, seed coating, seed pelleting, dormancy breaking treatments- **Seed certification** - phases of certification, procedure for seed certification, field inspection, field counts, field and seed standards. Post-harvest inspection - processing, bagging and tagging. Seed Act and Rules - **Seed law enforcement**. Duty and powers of seed inspector, offences and penalties. Seeds Control Order 1983 - Salient features of PPV&FRA 2001 - National Seed Policy 2002 - Seed Bill 2004. Seed testing for quality assessment - importance - Varietal identification through grow out test, molecular and biochemical test. Detection of genetically modified crops. **Seed storage** – principles- factors affecting seed longevity during storage – Seed treatments and packaging materials - measures for pest and disease control during storage and godown sanitation. **Seed marketing** - structure and organization - sales promotional activities. Factors affecting seed marketing and demand – **History of Indian Seed Industry**-International seed movement - role of international organizations, WTO and OECD in seed trade.

### **Practical**

Study on seed structure of major Cereals - rice, wheat, maize, sorghum and bajra - Pulses – green gram, blackgram, red gram, Bengal gram and field pea - Oilseeds - groundnut, sesame, sunflower, castor, soybean and mustard - Cotton - Forage crops – Green manures-Vegetable crops. Seed production techniques - identification of physical and genetic contaminants - Supplementary pollination in hybrid rice -Detasselling techniques in hybrid maize - Emasculation and dusting technique in cotton - Supplementary pollination in sunflower - Pre-germinative technique - Enhancing female flowers in cucurbits - Assessment of physiological maturity indices - Seed extraction methods in vegetables. Visit to seed production farms-Identification of off-types and Roguing - Seed enhancement techniques - seed coating, seed priming and seed pelleting, dormancy breaking treatments. Visit to seed processing plant-Study of Seed Processing machines- Seed certification - field inspection and counting procedures - Seed sampling and testing - Seed moisture content- Physical purity-Seed germination-Seed Viability - Seed and seedling vigour test - Seed health test- Genetic purity test -Grow out test and Electrophoresis - Seed production planning - Economics - Visit to seed testing laboratory.

### **Theory lecture schedule**

1. Seed and seed technology - definition -importance -Characters of good quality seed.
2. Seed development and maturation.
3. Germination - phases of seed germination - Dormancy - types of seed dormancy.
4. Different classes of seed - generation system of seed multiplication in supply chain - Seed replacement rate and varietal replacement - Seed Multiplication Ratio -Seed renewal period.
5. Varietal deterioration of crops - causes and maintenance.
6. Principles of seed production - factors affecting seed production - physical and genetic contaminants.
7. Seed production techniques in varieties and hybrids of rice.

8. Seed production techniques in varieties and hybrids of maize.
9. Seed production techniques in varieties and hybrids of sorghum and bajra.
10. Seed production techniques in greengram and blackgram varieties.
11. Seed production techniques in varieties and hybrids of redgram.
12. Seed production techniques in varieties and hybrids of sunflower and groundnut varieties.
13. Seed production techniques in varieties and hybrids of castor and sesame varieties.
14. Seed production techniques in varieties and hybrids of cotton.
15. Seed production techniques in Cenchrus species and lucerne.
16. Seed production techniques in varieties and hybrids of tomato, brinjal and chillies.
17. Seed production techniques in varieties and hybrids of bhendi and onion.

#### **18. Mid semester examination.**

19. Seed production techniques in varieties and hybrids of gourds – bitter gourd, ash gourd, snake gourd, ribbed gourd, bottle gourd and pumpkin.
20. Principles of Genetically Modified (GM) Crops and organic seed production.
21. Post harvest handling of seeds - threshing methods - drying - methods of seed drying.
22. Seed processing - principle - importance - seed processing sequence for different crops - equipments.
23. Principles and mechanism of seed cleaning and grading - processing equipments - cleaner cum grader – Upgrading-specific gravity separator.
24. Principles and mechanism of upgrading equipments - colour sorter - indented cylinder separator - spiral separator - magnetic separator - needle separator
25. Seed quality enhancement techniques - importance - seed fortification - seed priming - seed coating - seed pelleting-dormancy breaking treatments.
26. Seed certification - phases of certification, procedure for seed certification, field inspection, field counts, field and seed standards - post harvest inspection - processing - bagging and tagging.
27. Seed Act and Rules - Seed law enforcement - Duties and powers of seed inspector - offences and penalties - Seeds Control Order 1983.
28. Salient features of PPV&FRA, 2001 - National Seed Policy, 2002 - Seed Bill, 2004.
29. Seed testing for quality assessment - importance - methods.
30. Varietal Identification - Grow Out Test - molecular and biochemical tests - Detection of Genetically Modified crops.
31. Seed storage - principles - factors affecting seed longevity during storage.
32. Seed treatment and packaging materials - measures for pest and disease control during storage and godown sanitation.
33. Seed marketing - structure and organization - sales promotional activities - factors affecting seed marketing and demand.
34. History of Indian Seed Industry-History-International seed movement - Role of international organizations - WTO and OECD in seed trade.

#### **Practical schedule**

1. Study on external and internal seed structure and identification of major cereals - pulses - oilseeds - cotton - forage crops-green manures and vegetable crops.
2. Practicing supplementary pollination techniques in hybrid rice and detasselling techniques in hybrid maize.

3. Practicing emasculatation and dusting technique in cotton and supplementary pollination in sunflower.
4. Practicing pre-germinative technique and female flowers production enhancement techniques in cucurbits.
5. Assessment of physiological maturity indices in various crops and seed extraction methods in vegetables.
6. Visit to seed production farms-Identification of off-types and Roguing
28. Seed enhancement techniques - Seed coating - seed priming and seed pelleting-dormancy breaking treatments.
7. Seed certification - field inspection and counting procedure - identification of physical and genetic contaminants in seed production plots and roguing.
8. Seed testing - seed sampling - mixing - dividing - equipments.
9. Estimation of seed moisture content and physical purity.
10. Seed germination testing – Evaluation -Tetrazolium test for viability
11. Seed and seedling vigour test - brick gravel test, paper piercing test - cool and cold test - accelerated ageing test.
12. Genetic purity test - grow out test - electrophoresis.
13. Seed health testing - methods.
14. Seed production planning - economics.
15. Visit to seed processing plant and seed testing laboratory.
- 16. Final practical examination.**

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## **STA 201 Statistical Methods (1+1)**

### **Outcomes:**

- Understanding the applications of statistics in Agriculture.
- Understanding sampling theory, distribution, sampling methods, analysis of variance, correlations and regression.

### **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 SEMESTER 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  $2 \times 2$  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  $2 \times 2$  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**

## SEMESTER IV

Sl.No.	Course No.	Course Title	Cr.Hr.
1.	AEC 202	Agricultural Marketing Trade & Prices	2+1
2.	AEG 202	Soil and Water Conservation Engineering	1+1
3.	AGR 202	Crop Production Technology – I ( <i>Kharif Crops</i> )	2+1
4.	AGR 203	Farming System & Sustainable Agriculture	1+0
5.	AGR 204	Geoinformatics and Nano-technology and Precision Farming	1+1
6.	GPB 202	Fundamentals of Plant Biotechnology	2+1
7.	HOR 212	Production Technology for Ornamental Crops, MAP and Landscaping	1+1
8.	PAT 201	Principles of Integrated Disease Management	1+1
9.		Elective Course-1	2+1
10	PJN 201	Educational Tour - I (State)#	0+1
	NSS 101 / NCC 101	National Social Service / National Cadet Corps*	0+1
	PED 101	Physical Education & Yoga Practices*	0+1
TOTAL			13+9=22

\*Non-Gradual Course continued from first semester

# Non-Gradual Course

## **AEC 202 Agricultural Marketing, Trade and Prices (2+1)**

### **Outcomes:**

- Understanding importance of agricultural marketing, market structure, marketing mix and segmentation.
- Understanding marketing functions, pricing and promotion strategies, marketing efficiency and marketing institutions.

### **Theory**

#### **Unit 1: Agricultural Marketing – Nature and Scope**

Agricultural Marketing: Concepts and definitions of market, marketing, agricultural marketing, market structure, marketing mix and market segmentation, classification and characteristics of agricultural markets; nature and determinants of demand and supply of farm products. Producer's surplus – meaning and its types, marketable and marketed surplus, factors affecting marketable surplus of agri-commodities. Approaches to the study of marketing - Market functionaries and Market forces. Marketing of agricultural versus manufactured goods.

#### **Unit 2: Marketing Functions, Pricing and Promotion strategies**

Marketing process and functions: Marketing process - concentration, dispersion and equalization; exchange functions – buying and selling; physical functions – storage, transport and processing; facilitating functions – packaging, branding, grading, quality control and labeling (AGMARK); Standardization, Finance, Storage and Warehousing, Processing, Value Addition and Risk Taking - Market Structure, Conduct and Performance paradigm (SCP) – Market Structure: Meaning, Components, Dynamics of Conduct and Performance – Price determination under perfect and imperfect competition.

Product Life Cycle (PLC) and competitive strategies: Meaning and stages in PLC; characteristics of PLC; strategies in different stages of PLC; pricing and promotion strategies: pricing considerations and approaches – cost based and competition based pricing; market promotion – advertising, personal selling, sales promotion and publicity – their meaning and merits and demerits.

#### **Unit 3: Marketing Efficiency and Marketing Institutions**

Market functionaries and marketing channels: Types and importance of agencies involved in agricultural marketing; meaning and definition of marketing channel; number of channel levels; marketing channels for different farm products; Integration over space, time and form: Meaning, definition and types of market integration; marketing efficiency; marketing costs, margins and price spread; factors affecting cost of marketing, reasons for higher marketing costs of farm commodities; ways of reducing marketing costs; Modern marketing systems versus traditional agricultural marketing systems; Role of Government in agricultural marketing - Public sector institutions - CWC, SWC, FCI and DMI – their objectives and functions; cooperative marketing in India; New EXIM policy of India – Advantages of AEZs, ITPO, Export Promotion Councils, APEDA, MPEDA, and Commodity Boards.

#### **Unit 4: Trade in Agricultural Products**

International Trade: Concept of International Trade and its need - Free trade, Autarky and its needs - Theories of Trade: Absolute and comparative advantage; Present status and prospects of Agricultural exports / imports from India and their share - Barriers to Trade: Tariff and non-tariff barriers - Trade policy instruments – Terms of Trade - Role of institutions like UNCTAD and GATT - WTO in promoting trade in agricultural products - Free Trade Agreements – AoA and its implications on Indian agriculture: Sanitary and Phyto-sanitary issues, Market Access, Domestic Support and Export Subsidies - IPR.

#### **Unit 5: Agricultural Prices and Risk Analysis**

Agricultural Prices and Policy: Meaning and functions of price; administered prices; need for agricultural price policy; Objectives of Price Policy and Price Stabilization – Role of CACP – Concept of MSP, FRP (SMP) and SAP – Price Parity - Procurement of food grains and buffer stock - Risk in marketing: Meaning and Importance - Types of risk in marketing: Speculation and Hedging and Forward and Futures trading; an overview of futures trading; – Role of Contract Farming in risk mitigation.

#### **Practical**

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

#### **Theory Schedule**

1. Agricultural Marketing: Concepts and definitions of market, marketing, agricultural marketing.
2. Market structure, marketing mix and market segmentation, classification and characteristics of agricultural markets.
3. Demand and supply of agri-commodities: meaning, nature and determinants of demand and supply of farm products.
4. Approaches to the study of marketing: Market functionaries and Market forces.
5. Marketing of agricultural versus manufactured goods. Producer surplus – meaning and its types, marketable and marketed surplus, factors affecting marketable surplus of agri-commodities.
6. Marketing process and functions: Marketing process - concentration, dispersion and equalization.
7. Exchange functions – buying and selling; physical functions – storage, transport and processing.

8. Facilitating functions – packaging, branding, grading, quality control and labeling (AGMARK).
9. Standardization, Finance, Storage and Warehousing, Processing, Value Addition and Risk Taking.
10. Market Structure, Conduct and Performance paradigm (SCP) – Market Structure: Meaning, Components, Dynamics of Conduct and Performance.
11. Market structure and Price determination under perfect and imperfect competition.
12. Product Life Cycle (PLC) and competitive strategies: Meaning and stages in PLC; characteristics of PLC; strategies in different stages of PLC.
13. Pricing and promotion strategies: pricing considerations and approaches – cost based and competition based pricing.
14. Market promotion – advertising, personal selling, sales promotion and publicity – their meaning and merits and demerits.
15. Market functionaries and marketing channels: Types and importance of agencies involved in agricultural marketing; meaning and definition of marketing channel; number of channel levels; marketing channels for different farm products.
16. Integration overspace, time and form: Meaning, definition and types of market integration.

#### **17. Mid-Semester Examination**

18. Marketing efficiency; marketing costs, margins and price spread; factors affecting cost of marketing reasons for higher marketing costs of farm commodities; ways of reducing marketing costs.
19. Role of Government in agricultural marketing - Modern marketing systems versus traditional agricultural marketing systems.
20. Public sector institutions- CWC, SWC, FCI, and DMI – their objectives and functions.
21. Co-operative marketing in India.
22. Advantages of AEZs, ITPO, Export Promotion Councils, APEDA, MPEDA, and Commodity Boards.
23. International Trade: Concept of International Trade and its need - Free trade, Autarky and its needs.
24. Theories of Trade: Absolute and comparative advantage;
25. Present status and prospects of Agricultural exports / imports from India and their share.
26. Barriers to Trade: Tariff and non-tariff barriers - Trade policy instruments.
27. Terms of Trade - Role of institutions like UNCTAD and GATT - WTO in promoting trade in agricultural products - Free Trade Agreements.
28. AoA and its implications on Indian agriculture: Sanitary and Phyto-sanitary issues, Market Access, Domestic Support and Export Subsidies - IPR.
29. Agricultural Prices: Meaning and functions of price; administered prices; need for agricultural price policy; Objectives of Price Policy and Price Stabilization – Role of CACP – Concept of MSP, FRP (SMP) and SAP.
30. Price Parity - Procurement of food grains and buffer stock.
31. Risk in marketing: Meaning and Importance - Types of risk in marketing. Role of Contract Farming in risk mitigation.
32. Speculation and Hedging and Forward and Futures trading: an overview of futures trading.

### **Practical Schedule**

1. Preparation of farm survey schedule
2. Visit to a farm to collect information on marketing practices of agricultural commodities and marketing problems.
3. Computation of marketable and marketed surplus of important commodities.
4. Visit to a local market / weekly *shandy* / farmers' market to study various marketing functions performed by different agencies.
5. Identification of marketing channels for selected commodity.
6. Marketing costs, margins; price spread estimation for major agricultural and allied agricultural products.
7. Estimation of marketing efficiency and market integration.
8. Visit to market committee and regulated market to study their organization and functioning.
9. Visit to co-operative marketing society to study its organization and functioning.
10. Visit to Food Corporation of India (FCI)
11. Visit to market institutions – SWC / CWC to study their organization and functioning.
12. Visit to AGMARK Laboratory / Grading institutions.
13. Visit to NAFED
14. Visit to Commodity Boards / AEZ / Export oriented units.
15. Construction of Index Numbers and their uses.
16. Application of principles of comparative advantage of international trade.
17. **Practical Examination.**

### **References**

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## **AEG 202 SOIL AND WATER CONSERVATION ENGINEERING (1+1)**

### **Outcomes:**

- In-depth understanding about surveying and leveling of soil, soil erosion, water and wind erosion.
- Understanding about soil conservation and water harvesting.

### **Theory:**

#### **UNIT I: Surveying and Leveling**

Surveying - chain, cross staff, compass and plane table surveying - computation of angles - WCB - QB - RB - FB and BB. Leveling - types of leveling - dumpy level - Back sight - fore sight - inter mediate site - observation and tabulation of readings - difference in elevation.

#### **UNIT II: Soil Erosion**

Soil erosion - causes of soil erosion – erosivity - erodability - detachability and transportability - evil effects of soil erosion - geological and accelerated erosion. Definition and agents of soil erosion - factors affecting soil erosion - soil loss measurement techniques - Soil loss estimation by Universal Loss Soil Equation.

#### **UNIT III : Water Erosion**

Water erosion - forms of water erosion - causes of water erosion - mechanics of water erosion - factors affecting water erosion. Types of water erosion - splash, sheet, rill, gullyerosion, ravine landslides. Gully erosion - mechanics of gully erosion - stages of gully development - gully classification and control measures.

#### **UNIT IV: Wind Erosion**

Wind' erosion: mechanics of wind erosion, types of soil movement - suspension, saltation and surface creep; Factors affecting wind erosion. Principles of wind erosion control and its control measures. Biological control measures of wind erosion - contour cultivation, strip cropping - types of strip cropping, vegetative barrier, wind breaks, shelterbelts - shifting cultivation - limitations of biological measures.

#### **UNIT V: Soil Conservation and Water Harvesting**

Introduction to soil and water conservation - contour bund, graded bund and bench terracing. Grassed water ways and their design. Water harvesting - importance and techniques water harvesting structures - farm ponds and percolation ponds - lining of ponds, tanks and canal system.

### **Practical:**

General status of soil conservation in India. Calculation of erosion index. Estimation of soil loss. Measurement of soil loss. Preparation of contour maps. Design of grassed water ways. Design of contour bunds. Design of graded bunds. Design of bench terracing system. Problem on wind erosion.

**Lecture Schedule:**

1. Surveying - uses of surveying - classification of surveying - measurement of distance – chain - types of chain
2. Chain surveying, cross staff surveying, compass surveying and plane table surveying - computation of angles - WCB - QB - RB - FB and BB.
3. Levelling - types of leveling - dumpy level - setting.
4. Back sight - fore sight - inter mediate site - observation and tabulation of readings - difference in elevation.
5. Soil erosion - causes of soil erosion - erosivity - erodability - detachability and transportability - evil effects of soil erosion - geological and accelerated erosion - definition and agents of soil erosion.
6. Factors affecting soil erosion - soil loss estimation - soil loss measurement techniques - multi slot device - empirical equation - USLE.
7. Water erosion – Forms of water erosion - causes of water erosion - mechanics of water erosion - factors affecting water erosion.
8. Types of water erosion - splash, sheet, rill, gully erosion, ravine landslides.
9. **MID SEMESTER EXAM**
10. Gully erosion - mechanics of gully erosion - stages of gully development - gully classification and control measures.
11. Wind erosion - mechanics of wind erosion - types of soil movement- suspension, saltation and surface creep - factors affecting wind erosion.
12. Principle of wind erosion control and its control measures for agricultural lands.
13. Biological control measures of wind erosion - contour cultivation, strip cropping- types of strip cropping.
14. Biological control measures of wind erosion - vegetative barrier, wind breaks, shelterbelts - shifting cultivation - limitations of biological measures.
15. Introduction to soil and water conservation - contour bund, graded bund and bench terracing. Grassed water ways and their design.
16. Water harvesting – importance and techniques - Water harvesting structures- farm ponds, percolation pond - lining of ponds, tanks and canal system.

**Practical Schedule:**

1. Study of survey instruments
2. Study of leveling instruments.
3. Chains and cross staff surveying - linear measurement - plotting and finding areas.
4. Compass survey - observation of bearings - computation of angles.
5. Determination of difference in elevation by using dumpy level.
6. General status of soil conservation in India.
7. Calculation of erosion index.
8. Estimation of soil loss by Universal Soil Loss Equation
9. Measurement soil loss by multi slot device
10. Problems on wind erosion.
11. Preparation of contour maps.
12. Design of contour bund.



13. Design of graded bund.
14. Design of grassed water ways.
15. Design of bench terracing system.
16. Visit to soil and water conservation areas.
17. **FINAL PRACTICAL EXAMINATION.**

#### **References:**

1. Basak, N.N. 2008. Surveying and Levelling. 25th reprint. Tata Mc-Graw Hill Publishing Company Ltd
2. Ghanshyam Das., 2012. Hydrology and Soil Conservation Engineering,
3. Murthy, V. V.N., 2004. Land and Water Management Engineering. Kalayani Publishers, New Delhi
4. Mal, B. C. 1995. Introduction to Soil and Water Conservation Engineering. Kalayani Publishers, Rajinder Nagar, Ludhiana
5. Kanetakar, T. P. 1993. Surveying and Leveling. Pune VidyarthiGriha, Prakashan, Pune
6. Suresh, R. 2008. Land and Water Management. Standard Publishers Distributors, Delhi

### **AGR 202 CROP PRODUCTION TECHNOLOGY – I ( KHARIF CROPS) ( 2+1)**

#### **Outcomes:**

- In-depth understanding about origin, distribution, economic importance, soil and climate requirements of cereals and millets, pulses, oilseeds. Green manure and fibre crops.
- Understanding production technology and cultural practices of cereals, millets, pulses and oilseeds etc.

#### **Theory :**

Origin, geographical distribution, economic importance, soil and climatic requirements, varieties, cultural practices and yield of

#### **Unit I: Cereals and Millets**

Rice and Maize - Sorghum, Pearl millet, Finger millet and minor millets (Foxtail millet, Little millet, Kodo millet, Common millet and Barnyard millet)

#### **Unit II: Pulses**

Redgram, Blackgram, Greengram, Horse gram and Cowpea.

#### **Unit III: Oilseeds and Green Manure crops**

Groundnut, Sesame, Soybean, Castor and Niger  
Daincha, *Sesbania rostrata*, sunhemp, tephrosia

#### **Unit IV: Fibre and Narcotic crops**

Cotton, jute, Mesta, Sunhemp and Tobacco

#### **Unit V: Tuber and Forage crops**

Tapioca, Fodder maize, Fodder sorghum, Fodder pearl millet, Fodder cowpea, Fodder cluster bean and Bajra-Napier Hybrid grass

#### **Practical:**

Rice nursery preparation, transplanting of rice, sowing of soybean, pigeonpea and mungbean. maize, groundnut and cotton, effect of seed size on germination and seedling vigour of *kharif* season crops, effect of sowing depth on germination of *kharif* crops, identification of weeds in *kharif* season crops, top dressing and foliar feeding of nutrients, study of yield contributing characters and yield calculation of *kharif* season crops, study of crop varieties and important agronomic experiments at experimental farm. study of forage experiments, morphological description of *kharif* season crops, visit to research centres of related crops.

#### **Lecture Schedule:**

1. Importance, area, production and productivity of cereals and millets in world, India and Puducherry
2. Rice - Origin - geographic distribution - economic importance – soil and climatic requirement.
3. Rice -Important Varieties and hybrids, Transgenic Rice
4. Rice - Systems of rice cultivation, System of Rice Intensification
5. Rice - cultural practices – yield - economic benefits.
6. Maize - Origin, geographical distribution, economic importance, soil and climatic requirements, varieties, cultural practices and yield.
7. Sorghum - Origin, geographic distribution, economic importance, soil and climatic requirement, varieties, cultural practices and yield.
8. Pearl millet - Origin, geographic distribution, economic importance, soil and climatic requirement, varieties, cultural practices and yield
9. Finger millet - Origin, geographic distribution, economic importance, soil and climatic requirement, varieties, cultural practices and yield.
10. Minor millets - Foxtail millet, little millet, Kodo millet, Common millet and barnyard millet -Origin, geographic distribution, economic importance, soil and climatic requirement, varieties, cultural practices and yield
11. Importance, area, production and productivity of pulses in world, India and Puducherry. Reasons for low productivity of pulses in India and Techniques to improve productivity
12. Pigeonpea - Origin, geographical distribution, economic importance, soil and climatic requirements, varieties, cultural practices and yield.
13. Blackgram and Greengram Cowpea - Origin, geographical distribution, economic importance, soil and climatic requirements, varieties, cultural practices and yield, Agronomy of rice fallow pulses.

14. Horse gram and Cowpea - Origin, geographical distribution, economic importance, soil and climatic requirements, varieties, cultural practices and yield.
15. Importance, area, production and productivity of oilseeds in world, India and Puducherry. Reasons for low productivity of oilseeds in India and Techniques to improve productivity
16. Groundnut - Origin, geographical distribution, economic importance, soil and climatic requirements, varieties, cultural practices and yield.
17. **MID SEMESTER EXAMINATION**
18. Sesame - Origin, geographical distribution, economic importance, soil and climatic requirements, varieties, cultural practices and yield.
19. Soybean - Origin, geographical distribution, economic importance, soil and climatic requirements, varieties, cultural practices and yield.
20. Castor - Origin, geographical distribution, economic importance, soil and climatic requirements, varieties, cultural practices and yield
21. Niger - Origin, geographical distribution, economic importance, soil and climatic requirements, varieties, cultural practices and yield
22. Importance of green manures, types of green manuring; GM Crops (Daincha, *Sesbania rostrata*, sunhemp, tephrosia) - Origin, geographical distribution, economic importance, soil and climatic requirements, varieties, cultural practices and yield
23. Cotton - Origin, geographical distribution, economic importance, soil and climatic requirements, varieties, cultural practices and yield.
24. Jute - Origin, geographical distribution, economic importance, soil and climatic requirements, varieties, cultural practices and yield.
25. Mesta and sunhemp - Origin, geographical distribution, economic importance, soil and climatic requirements, varieties, cultural practices and yield.
26. Tobacco - Origin, geographical distribution, economic importance, soil and climatic requirements, varieties, cultural practices, curing and yield.
27. Importance of forage crops in Indian agriculture.
28. Tapioca - Origin, geographical distribution, economic importance, soil and climatic requirements, varieties, cultural practices, curing and yield.
29. Fodder maize and fodder sorghum - Origin, geographical distribution, economic importance, soil and climatic requirements, varieties, cultural practices and yield.
30. Fodder pearl millet, fodder cowpea and fodder cluster bean - Origin, geographical distribution, economic importance, soil and climatic requirements, varieties, cultural practices and yield.
31. Bajra-Napier - Origin, geographical distribution, economic importance, soil and climatic requirements, varieties, cultural practices and yield.
32. Forage preservation techniques

**Practical Schedule:**

1. Identification of seeds of *kharif* crops
2. Acquiring skill in different seed treatment techniques for *kharif* crops.
3. Practicing various nursery types and main field preparation for rice.
4. Layout and raising of crop cafeteria

5. Acquiring skill in nursery preparation and sowing of important millets.
6. Acquiring skill in main field preparation, manuring and sowing/transplanting of *kharif* crops.
7. Calculation of seed rate and plant population per unit area of *kharif* crops.
8. Acquiring skill in after cultivation practices of cereals, millets and pulses.
9. Acquiring skill in after cultivation practices of oilseeds, fibre and forage.
10. Observations on growth parameters/morphological description of *kharif* crops.
11. Study of yield parameters and yield estimation in *kharif* crops.
12. Acquiring skill in harvesting of *kharif* crops
13. Working out cost and returns of *kharif* crops.
14. Study of crop varieties and important agronomic experiments at experimental farm
15. Visit to farmers field / experimental farm to acquire skill in mechanisation.
16. Visit to nearby Forage farm/ Agricultural Research Station / Farmer's field.
17. **PRACTICAL EXAMINATION.**

#### References:

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2. Chidda Singh. 2010. Modern techniques of raising field crops. Oxford and IBH Publishing Co. Pvt. Ltd, New Delhi.
3. Crop production Guide 2012. Directorate of Agriculture, Chennai.
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### **AGR 203 FARMING SYSTEM AND SUSTAINABLE AGRICULTURE (1 + 0)**

#### Outcomes:

- Understanding the concepts, principles of cropping system, farming systems and sustainable farming practices.
- Understanding Integrated Farming System and resource management in IFS.

#### Theory

##### Unit I: Cropping system

Cropping systems - Definition - Principles - Concepts - Classification – mono cropping – intensive cropping - cropping systems of India and Tamil Nadu - Interaction between different

cropping systems – Cropping system management – Resource management – land, nutrient, water and weed - Indices for evaluation of cropping systems - Land use - yield advantages - Economic evaluation

### **Unit II: Farming systems**

Farming systems - Definition - Principles - Concepts - Enterprises selection and management - interaction between different enterprises with cropping – scope and advantages of Integrated Farming system – evaluation indicators of integrated farming system - Integrated farming system models for different agro eco-systems - LEISA concepts and principles.

### **Unit III: Sustainable farming practices**

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

### **Unit IV: IFS**

Farming systems models- Definition - Principles - Concepts - Scope and advantages of Integrated Farming system – Study of models of Integrated Farming System-Wetland- Garden land- Dryland-various components of IFS. Study of different units: dairy, goat, poultry, fishery. Mushroom, sericulture and biogas

### **Unit V: Resource management in IFS**

Resource management under IFS – Cost reduction strategies in crop production – cropping system, farming system and dry farming – Non-monetary inputs and low cost technologies - Labour management – Resource recycling – Residue management – crop and livestock – Conservation agriculture – principles, concept and scope- Sustainable Agriculture- introduction, definition-goal.

### **Lecture Schedule**

1. Cropping systems - Definition - Principles - Concepts
2. Classification – mono cropping – intensive cropping - cropping systems of India and Tamil Nadu
3. Cropping system management – Resource management
4. Indices for evaluation of cropping systems and Land use
5. Indices for evaluation of yield advantages - Economic evaluation
6. Farming systems - Definition - Principles - Concepts
7. Enterprises selection and management - interaction between different enterprises
8. Scope, advantages and evaluation indicators of Integrated Farming system
- 9. MID-SEMESTER EXAMINATION**
10. Integrated farming system models for different agro eco-systems and resource recycling
- 11.** Study of models of Integrated Farming System -Wetland- Garden land- Dryland-various components of IFS. Study of different units: dairy, goat, poultry, fishery. Mushroom, sericulture and biogas
12. Non-monetary inputs and low-cost technologies - Labour management
13. Conservation agriculture – principles, concept and scope

14. Sustainable farming – Definition, Concept and practices
15. Bio-dynamic farming, Permaculture, Organic Farming, IFS, LEISA
16. Good Agriculture practices

## **References**

1. Jayanthi, C. Devasenapathy, P and C. Vennila. 2007. Farming Systems. Principles and practices. Satish Serial Publishing House.Delhi.
2. Devasenapathy, P., T. Ramesh and B. Gangwar 2007.Efficiency indices for agriculture management research. New India Publishing agency, Delhi.
3. Jayanthi, C., N. Sakthivel, N. Sankaran and T.M. Thiyagarajan. 2003. Integrated Farming system – A Path to Sustainable Agriculture. TNAU Publication.
4. S.C. Panda. 2003. Cropping and Farming Systems. Agrobios Publishers. Jodhpur.
5. Palaniappan, SP and K. Sivaraman.1996. Cropping systems in the tropics - Principles and management. New Age International (P) Ltd., New Delhi.

## **AGR 204 GEOINFORMATICS, NANO-TECHNOLOGY AND PRECISION FARMING (1+1)**

### **Outcomes:**

- Understanding Precision Agriculture, GIS, Remote sensing and GPS
- Understanding Nanotechnology concepts and Applications of nanotechnology

### **Theory:**

#### **Unit I : Precision Agriculture**

Precision agriculture: concepts and techniques; their issues and concerns for Indian agriculture; Geo-informatics- definition, concepts, tool and techniques; their use in Precision Agriculture.

#### **Unit II: GIS**

Crop discrimination and Yield monitoring, soil mapping; fertilizer recommendation using geospatial technologies; Spatial data and their management in GIS;

#### **Unit III: Remote sensing and GPS**

Remote sensing concepts and application in agriculture; Image processing and interpretation; Global positioning system (GPS), components and its functions Introduction to crop Simulation Models and their uses for optimization of Agricultural Inputs; STCR approach for precision agriculture.

#### **Unit IV: Nanotechnology concepts**

Nanotechnology, definition, concepts and techniques, synthesis of nanomaterials - brief introduction about nanoscale effects, nano-particles, nano-pesticides, nano-fertilizers, nano-sensors.

## **Unit V: Applications of nanotechnology**

Use of nanotechnology in seed, water, fertilizer, plant protection for scaling-up farm productivity. Energy, Environment, Health and Nanotoxicology

### **Practical:**

Introduction to GIS software, spatial data creation and editing. Introduction to image processing software. Visual and digital interpretation of remote sensing images. Generation of spectral profiles of different objects. Supervised and unsupervised classification and acreage estimation. Multispectral remote sensing for soil mapping. Creation of thematic layers of soil fertility based on GIS. Creation of productivity and management zones. Fertilizers recommendations based on VRT and STCR techniques. Crop stress (biotic/abiotic) monitoring using geospatial technology. Use of GPS for agricultural survey. Formulation, characterization and applications of nanoparticles in agriculture. Projects formulation and execution related to precision farming.

### **Lecture Schedule:**

1. Precision agriculture- introduction, scope, concepts and techniques , components and its implications, issues ,role and concerns in Indian agriculture.
2. Geo informatics- definitions and terminology, concepts,
3. Geo-informatics- techniques and tools ,their use in precision agriculture.
4. Crop discrimination and yield monitoring, soil mapping; fertilizer recommendation using geospatial technologies.
5. IS -components of GIS, Spatial data and their management ,Graphic representation of data- Vector /Raster- models-digitization.
6. Remote sensing- concepts – applications in agriculture; Images – sensor systems- satellites, types- NOAA satellites, GOES satellites, INSAT,IRS, SEASAT,OCEANSAT-1,IKONOS Image processing and interpretation
7. Global positioning Systems (GPS)- components, functions and applications.
8. Crop simulation models - Application of modelling in agriculture - crop yield models- growth models
9. **MID-SEMESTER EXAMINATION**
10. Soil fertility management- Soil Test crop response ( STCR) studies - Integration of Remote sensing and GIS - need for integration-applications.
11. Nanotechnology – introduction – history – terminologies – definitions – basic principles, concepts, nano scale, nano dimension effects.
12. Nanoparticles, nano materials, nano structures – their properties
13. Synthesis of nano particles – concepts , up - down and bottom-up approaches, physical methods – attrition, pyrolysis ,chemical synthesis – soil gel process .
14. Nano technology in agriculture – nano fertilizers, nano pesticides, soil binders, nano sensors
15. Use of nanotechnology in seed, water, fertilizer, plant protection for scaling-up farm productivity.

16. Nanotechnological applications in energy, environment, health sciences and nanotoxicology

**Practical Schedule:**

1. Introduction to GIS software, spatial data creation and editing.
2. Introduction to image processing software. Visual and digital interpretation of remote sensing images
3. Generation of spectral profiles of different objects.
4. Supervised and unsupervised classification and acreage estimation.
5. Multispectral remote sensing for soil mapping.
6. Creation of thematic layers of soil fertility based on GIS.
7. Creation of productivity and management zones using GIS.
8. Fertilizers recommendations based on VRT and STCR techniques.
9. Crop stress (biotic/abiotic) monitoring using geospatial technology.
10. Use of GPS for agricultural survey
11. Synthesis of nanoparticles by chemical reduction
12. Synthesis of nanoparticles using plant extracts
13. Application of nanoparticles for seed treatment and as
14. Application of nanopartilces as nano-fertilizer
15. Visit to nanotechnology lab.
16. Projects formulation and execution related to precision farming.
17. **PRACTICAL EXAMINATION**

**References:**

1. Burrough.P.A.1983. Geographical information systems for natural resource assessment. Newyork, Oxford University press.
2. Curran.P.1989. Principles of Remote sensing. Longman ,London
3. Lillesand, T.M. and Kiefer, R. W. 1994. Remote sensing and image interpretation.
4. Pradeep. T. 2007. NANO: The Essentials:Understanding Nanoscience andNanotechnology.Tata McGraw-Hill Publishing Company Limited, New Delhi
5. Subramanian, K. S. K. Gunasekaran, N. Natarajan, C.R. Chinnamuthu, A.Lakshmanan and S. K Rajkishore. 2014. Nanotechnology in Agriculture. New India Publishing House, New Delhi pp. 440 ISBN. 9789383305209



## GPB 202 FUNDAMENTALS OF PLANT BIOTECHNOLOGY (2+1)

### Out comes:

- In depth understanding of basic and applied aspects of Plant tissue culture
- Understanding recombinant DNA technology and Genetic Transformation, Molecular Marker technology and Molecular breeding.

### 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 - secondary metabolite production- invitro germplasm conservation

#### Unit III: Basic Molecular Biology

Genome organization- prokaryotes vs eukaryotes- Central dogma of life - Structure of nucleic acids - DNA replication - genetic codes- transcription, translation and protein synthesis- Structure of a gene, regulation of gene expression, Operon concept- basic techniques in molecular biology-Blotting techniques- Polymerase chain reaction- DNA sequencing methods.

#### 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- Molecular analysis of transgenic plants – Transgenesis, Cisgenesis, Epigenesis and Genome editing- 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-principles, methods and applications of Marker Assisted Selection in crop improvement- Omics technology - Applications of Plant Genomics and genome databases.

## 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 field

## 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
5. Anther and pollen culture (doubled haploids), ovule and embryo culture, *In vitro* fertilization
6. Micropropagation - banana and ornamental plants
7. Meristem tip culture (virus free plants)
8. National certification and Quality management of TC plants
9. Protoplast isolation and fusion
10. Somatic embryogenesis - synthetic seeds, Secondary metabolite production, *invitro* germplasm conservation
11. Genome organization- prokaryotes vs eukaryotes
12. Central dogma of life - Structure of nucleic acids
13. DNA replication- Mechanism
14. Transcription and Post transcriptional processing - RNA splicing
15. Translation - genetic codes and protein synthesis
16. Concept and structure of a gene- classical and modern concept, Regulation of gene expression, Operon concept
- 17. Mid semester Examination**
18. Blotting techniques and Polymerase chain reaction
19. DNA sequencing methods
20. DNA manipulation enzymes: Polymerases, restriction endonucleases and ligases
21. Different types of vectors: plasmids, phagemids, cosmids, BAC
22. Construction of recombinant DNA molecules- Bacterial transformation
23. Direct and indirect gene transfer methods in plants: microinjection, electroporation, particle bombardment, *Agrobacterium* mediated method
24. Tissue specific promoters, selectable and scorable markers, reporter genes, Molecular analysis of transgenic plants, Transgenesis, Cisgenesis, Epigenesis and Genome editing
25. Transgenic plants: herbicide, pest and disease resistant, abiotic stress resistant,
26. Transgenic plants: nutritional enhancement and traits for improved quality
27. Detection of GMOs – regulations and biosafety.

28. DNA markers - hybridization based markers (RFLP) - PCR based markers: RAPD, SSR, AFLP, and SNPs
29. DNA fingerprinting of crop varieties
30. Development of mapping populations, Linkage and QTL analysis
31. Principles, methods and applications of Marker Assisted Selection in crop improvement
32. Omics technology and Applications of Plant Genomics and genome databases, Bioinformatics

### **Practical schedule**

1. Biotech Laboratory: Organization and Safety Regulations
2. Basics of Reagents and Solution Preparation
3. Plant Tissue Culture Media Preparation
4. Sterilization 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**

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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)
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2. <http://www.agbioworld.org>
3. <http://www.agbiosafety.unl.edu/>.

### **HOR 212      PRODUCTION TECHNOLOGY FOR ORNAMENTAL CROPS, MEDICINAL      1+1 AND AROMATIC PLANTS AND LANDSCAPING**

#### **Out comes:**

- In depth understanding of Scope and importance of ornamental crops, medicinal and aromatic plants and landscaping, Production technology of important cut flowers and loose flowers and Production technology of medicinal crops.
- Understanding of Production technology of aromatic crops and Postharvest technology of ornamental crops, medicinal and aromatic plants

#### **Theory**

#### **Unit -I: Scope and importance of ornamental crops, medicinal and aromatic plants and landscaping**

Importance and scope of ornamental crops, medicinal and aromatic plants and landscaping. Principles of landscaping. Landscape uses of trees, shrubs and climbers.

#### **Unit -II: Production technology of important cut flowers and loose flowers**

Flower crops - 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 following flower crops (Rose, gerbera, carnation, lilium and orchids under protected conditions and gladiolus, tuberose, chrysanthemum under open conditions. Jasmine, Marigold, Crossandra, Gomphrena under open conditions)

#### **Unit -III: Production technology of medicinal crops**

Medicinal plants – introduction – uses - current status of area and production - Soil and Climate- varieties and related species – propagation and planting – weed and water management – Nutrient management- Harvesting – Postharvest Handling for the following crops (Ashwagandha, Asparagus, Aloe, costus, senna, coleus, periwinkle, isabgol)

#### **Unit -IV: Production technology of aromatic crops**

Aromatic plants - Introduction – uses –current status of area and production - soil and climate- varieties and related species – propagation and planting – weed and water management – Nutrient management- Harvesting – Postharvest Handling of Mint, lemongrass, citronella, palmarosa, ocimum, rose, geranium, vetiver.

#### **Unit-V: Postharvest technology of ornamental crops, medicinal and aromatic plants**

Processing and value addition in ornamental crops, medicinal and aromatic plants produce.

#### **Practical**

Identification of Ornamental plants. Identification of Medicinal and Aromatic Plants. Nursery bed preparation and seed sowing. Training and pruning of Ornamental plants. Planning and layout of garden. Bed preparation and planting of medicinal and aromatic plants. Protected structures – care and maintenance. Intercultural operations in flowers and MAP. Harvesting and post harvest handling of cut and loose flowers. Processing of medicinal and aromatic plants. Visit to commercial flower/MAP unit.

#### **Lecture Schedule:**

1. Importance and scope of ornamental crops and landscaping - Landscape uses of trees, shrubs and climbers.
2. Principles of landscaping - Initial approach – Axis – Focal Point – Mass effect – Unity – Space – Divisional Lines – Proportion and Scale – Texture – Time and Light – Tone and Colour – Mobility – Rhythm – Balance – Contract – Harmony- Vista –Style.
3. Production technology of cut flowers under protected conditions - Rose –Introduction- origin and distribution - Classification- Species and varieties - Climate and soil requirements - Propagation – Rootstocks - Stock scion compatibility - Land preparation – planting - Manures and fertilizers - Cultural operations (pruning-pinching and mulching) harvesting - Post harvest management - Yield and rose bi-products.
4. Gerbera – Introduction - Origin and distribution – Classification - Species and varieties - Climate and soil requirements – Propagation - Land preparation – Planting - Manures and fertilizers - Cultural operations – Defoliation - Soil loosening- Shading-use of growth regulators - Physiological disorders – Harvesting - Post harvest management and yield.
5. Carnation – Introduction - Origin and distribution- Classification - Species and varieties - Climate and soil requirements - Propagation - Land preparation- Planting - Manures and fertilizers - Cultural operations- (Pinching and disbudding) use of growth regulators - Physiological disorders - Harvesting - Post harvest management and yield.
6. Liliun and Orchids - Introduction- Origin and distribution- Classification- Species and varieties- Climate and soil requirements- Propagation- Land preparation-Planting- Manures and fertilizers- Cultural operations - Use of growth regulators-Physiological disorders- Harvesting- Post harvest management and yield.

7. Production technology of cut flowers under open conditions - Gladiolus and Tuberose-  
Introduction - Origin and distribution - Classification of varieties - Species and varieties -  
Climate and soil requirements - Propagation - Land preparation – Planting - Manures and  
fertilizers - Cultural operations - Use of growth regulators-Physiological disorders –  
Harvesting - Post harvest management and yield.
8. Chrysanthemum – Introduction - Origin and distribution – Classification - Species and  
varieties - Climate and soil requirements – Propagation - Land preparation - Planting,  
Manures and fertilizers - Cultural operations - Pinching and disbudding - Use of growth  
regulators- Harvesting - Post harvest management and yield.

## **9. MID SEMESTER EXAMINATION**

10. Loose flowers - Marigold and Jasmine under open conditions – Introduction – Origin and  
distribution - Species and varieties - F1 hybrids - Climate and soil requirements -  
Propagation- Land preparation – Planting - Manures and fertilizers - Cultural operations-  
Pinching and disbudding - Use of growth regulators – Harvesting - Postharvest  
management and yield.
11. Medicinal plants – Scope and Importance – Production technology of Asparagus, Aloe,  
Costus - Botanical name – Family - Origin - Economic part - Introduction – Climate – Soil -  
Varieties – Propagation – Planting - Manuring - Irrigation -Intercultural operations -  
Harvesting - Yield.
12. Periwinkle, Isabgol -Botanical name – Family - Origin - Economic part -Introduction – Climate  
– Soil – Varieties – Propagation – Planting - Manuring – Irrigation – Intercultural  
operations - Harvesting - Yield.
13. Aromatic plants – Importance – Essential oil industry in India – Properties of essential oils –  
Production technology of Mint and Ocimum - Botanical name –Family - Origin - Economic  
part - Introduction – Climate – Soil - Varieties –Propagation – Planting - Manuring - Irrigation  
- Intercultural operations -Harvesting - Yield.
14. Lemongrass, Citronella, Palmarosa - Botanical name – Family - Origin – Economic part -  
Introduction – Climate – Soil - Varieties – Propagation – Planting - Manuring- Irrigation -  
Intercultural operations - Harvesting - Yield.
15. Geranium and Vettiver - Botanical name – Family - Origin - Economic part - Introduction –  
Climate – Soil - Varieties – Propagation – Planting - Manuring -Irrigation - Intercultural  
operations - Harvesting - Yield.
16. Processing and value addition in ornamental crops and medicinal and aromatic plants –  
produce – Dry flower making - Extraction methods of essential oils.

## **Practical schedule**

1. Identification of ornamental plants.
2. Identification of Medicinal and Aromatic Plants.
3. Nursery bed preparation and flower seed sowing.
4. Training and pruning of roses.
5. Planning and layout of ornamental garden.
6. Bed preparation and planting of Medicinal and Aromatic Plants.
7. Protected structures – Care and maintenance.
8. Intercultural operations in flowers crops.

9. Intercultural operations in Medicinal and Aromatic plants.
10. Harvesting and post-harvest handling of cut and loose flowers.
11. Floral preservatives to prolong vase-life of cut flowers.
12. Drying / dehydration techniques for flower drying.
13. Processing of Medicinal and Aromatic Plants.
14. Extraction of essential oils.
15. Visit to commercial flower unit.
16. Visit to commercial medicinal and aromatic plants unit.
- 17. PRACTICAL EXAMINATION**

## References

1. Bose, T.K. 1999. Floriculture and Landscaping. Naya Prakash, Kolkatta.
2. Bose, T.K. and Yadav, L.P. 1992. Commercial Flowers. Naya Prakash, Kolkatta.
3. Randhawa, G.S. and Mukhopadhyaya, A. 1994. Floriculture in India. Allied Publishers Pvt. Ltd., New Delhi
4. Chattopadhyay, S.K. 2007. Commercial Floriculture. Gene-Tech Books, New Delhi
5. Srivastava, H.C. 2014. Medicinal and Aromatic Plants. ICAR, New Delhi.
6. Kumar, N., Abdul Khader, J.B.M, Rangaswamy, P and Irulappan, I. 2004. Introduction to Spices, Plantation Crops, Medicinal and Aromatic Crops. Oxford and IBH publishing Co, New Delhi.

**PAT 201**

**Principles of Integrated Disease Management**

**(1+1)**

## Outcomes:

- In-depth understanding of importance of IPM, Surveillance, detection and diagnosis of pest and diseases
- Understanding the Principles, tools and module of IPM

## THEORY

### Unit I: Importance of IPM

Categories of diseases - Economic importance of diseases - Pest risk analysis - Epidemiology - Role of weather factors in disease development

### Unit II: Surveillance, detection and diagnosis of pest and diseases

Disease surveillance and assessment - Forecasting of diseases - Calculation and dynamics of economic injury level - Detection and diagnosis of diseases - Seed health tests - Chemodiagnosis - Serodiagnosis - ELISA - PCR - Nucleic acid hybridization techniques for detecting plant pathogens

### **Unit III: Principles and tools of IPM**

Host plant resistance – Types of resistance - Mechanism of resistance and resistant varieties - Cultural practices - Ecological management of crop environment - Mechanical, physical practices in disease management - Plant quarantine - Phytosanitary certificate- Quarantine in India - Exotic diseases introduced into India

### **Unit IV: Principles and tools of IPM**

Chemical control of diseases – Pesticides - Different group of fungicides and antibiotics for disease management - Biological control of pest and diseases - Biopesticides and Antiviral principles - Method of application - Safety issues in pesticide uses

### **Unit V: IPM module for Insect pest and disease**

Development and validation of IPM modules for rice, groundnut, cotton, sugarcane, brinjal, bhendi, coconut and banana - Political, social and legal implication of IPM - Case histories of important IPM programmes - Implementation and impact of IPM module

### **PRACTICAL**

Methods of diagnosis and detection of various plant diseases - Methods of plant disease measurement - Assessment of crop yield losses and calculations based on economics of IDM - Major group of fungicides and antibiotics - Preparation of Bordeaux mixture and Bordeaux paste - calculation of spray fluid - Methods of application of fungicides - Special methods of application of fungicides - Botanicals in plant disease management - Identification of biocontrol agents - Mass multiplication of *Trichoderma*, *Pseudomonas*, *Bacillus* - Pre-immunization techniques in crop disease management - Plan and assess preventive strategies (IDM module) and decision making - IDM practices for soil borne, seed borne, air borne and vector borne diseases - Crop monitoring attacked by diseases - Awareness campaign at farmers' fields - Visit to commercial biocontrol production unit /seed testing laboratories

### **Theory schedule – Plant diseases**

1. Epidemiology – Role of weather factors in plant disease development - Boom and bust cycle in disease outbreak
2. Disease surveillance, assessment and forecasting of plant diseases
3. Diagnosis of plant diseases - Seed health tests, Chemodiagnosis - Serodiagnosis - ELISA - PCR - Nucleic acid hybridization techniques
4. Principles of crop disease management - Avoidance – Exclusion - Plant quarantine – domestic, international and embargo - Phytosanitary certificate - Quarantine in India. Post entry quarantine in India - Exotic diseases introduced into India
5. Principles of crop disease management - Eradication - Different methods of eradication of plant diseases
6. Principles of crop disease management - Protection - Physical and chemical methods - Fungicides - Ideal characters - Formulations - Safety measures to be followed while handling fungicides



7. Contact Fungicides - Sulphur fungicides, copper fungicides, mercury fungicides, heterocyclic nitrogen compounds , organo tin, quinone, benzene and miscellaneous compounds - classification and uses

#### **8. Mid semester examination**

9. Systemic fungicides including antibiotics - classification and uses
10. Methods of application of fungicides - Seed treatment, foliar spray, soil drenching and special methods of application - Compatibility and Phytotoxicity of fungicides
11. Biological control - Definition - Mechanism of action - Mass production - Methods of application
12. Botanicals in plant disease management - Antiviral principles - Preparation - Methods of application
13. Host plant resistance - Mechanisms of resistance - Cross protection
14. Resistant varieties - Biotechnological approaches - Tissue culture techniques - Meristem tip culture, somoclonal variation and transgenic plant production by genetic engineering.
15. IDM module for rice, groundnut, cotton and sugarcane
16. IDM module for brinjal, bhendi, coconut and banana

#### **Practical Schedule**

1. Diagnosis of plant diseases
2. Seed health testing methods
3. Survey and assessment of important plant diseases
4. Chemicals in plant disease management – Major group of fungicides and antibiotics
5. Preparation of Bordeaux mixture and Bordeaux paste
6. Calculation of spray fluid
7. Methods of application of fungicides
8. Special methods of application of fungicides
9. Botanicals in plant disease management
10. Mass production and methods of application of *Trichoderma viride*
11. Mass production and methods of application *Pseudomonas fluorescens*
12. Mass production and methods of application of *Bacillus subtilis*
13. Pre-immunization techniques in crop disease management
14. IDM practices for soil borne, seed borne, air borne and vector borne diseases
15. IDM awareness campaign at farmers fields.
16. Visit to commercial biocontrol production unit /seed testing laboratories

#### **Reference Books**

1. Arjunan.G. Karthikeyan, G, Dinakaran, D. and T. Raguchander. 1999 Diseases of Horticultural Crops, AE Publications, Coimbatore.
2. Rangasawmi, G. and A. Mahadevan. 1998. Diseases of crop Plants in India, Prentice Hall of India Pvt. Ltd., New Delhi
3. Prakasam, V., Valluvaparidasan, V., Raguchander, T. and K. Prabakar. 1997. Field crop diseases, AE Publication, Coimbatore.

**e- Books**

1. Agrios, G.N. 2008. Plant Pathology, Academic Press, New York
2. Rangaswami, G. 2005. Diseases of Crop plants in India. Prentice Hall of India Pvt. Ltd., New Delhi
3. Thakur, B.R. 2006. Diseases of field crops and their management

**PJN 201 Educational Tour – I (State) (0+1)****Outcome:**

- Understanding about the soil, climatic conditions and cropping patterns in the agro-climatic zones of Tamil Nadu and Puducherry.
- Understanding the first-hand information on latest technologies on various crops and allied activities

The students will undertake the short tour during third semester for seven days covering KVK's, Research stations, Sister campuses and ICAR institutes in the southern part of Tamil Nadu & Puducherry. The study tour will provide an exposure to the students to know about the soil, climatic conditions and cropping patterns in the respective agro-climatic zones. The students will also have first-hand information on latest technologies on various crops and allied activities.

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### SEMESTER V

Sl.No.	Course No.	Course Title	Cr.Hr.
1.	AEC 301	Intellectual Property Rights #	1+0
2.	AEG 301	Renewable Energy and Green Technology	1+1
3.	AEN 301	Pests of Crops and Stored Grain and their Management	2+1
4.	AEX 301	Communication Skills and Personality Development	1+1
5.	AGR 301	Practical Crop Production – I ( <i>Kharif</i> crops)	0+1
6.	AGR 302	Crop Production Technology –II ( <i>Rabi Crops</i> )	2+1
7.	AGR 303	Rainfed Agriculture & Watershed Management	1+1
8.	HOR 311	Production Technology for Fruit and Plantation Crops	1+1
9.	PAT 301	Diseases of Field and Horticultural Crops and their Management-I	2+1
10	SAC 301	Manures, Fertilizers and Soil Fertility Management	2+1
11.	---	Elective Course-2	2+1
TOTAL			15+10=25
# Team teaching			

## **AEC 301     Intellectual Property Rights     1+0**

### **Outcomes:**

- Understanding the meaning of intellectual property and brief introduction to GATT, WTO, TRIPS and WIPO, IPR protection and covering in India.
- In-depth understanding Patents Act 1970, UPOV, PPV & FR Act 2001, ITPGRFA, Indian Biological Diversity Act, 2002

### **Theory**

**Unit 1:** Introduction and meaning of intellectual property, brief introduction to GATT, WTO, TRIPS and WIPO, Treaties for IPR protection: Madrid Protocol, Berne Convention, Budapest Treaty, etc.

**Unit 2:** Types of IP and legislations covering IPR in India: Patents, copy rights, trademark, industrial design, geographical indication, integrated circuits and trade secrets.

**Unit 3 :** Patents Act 1970, Patent systems in India, patentability, process and product patent , filing of patent, patent specifications, patent claims, patent opposition and revocation, infringement, compulsory licensing, Patent Cooperation Treaty, patent search and patent data base.

**Unit 4 :** Origin, history including a brief introduction to UPOV for protection of plant varieties, protection of plant varieties under UPOV and PPV & FR Act of India , Plant Breeders rights, registration of plant varieties under PPV & FR Act 2001, breeders, researcher and farmers rights. Traditional knowledge - meaning and rights of TK holders.

**Unit 5:** Convention on Biological Diversity, International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA), Indian Biological Diversity Act, 2002 and its salient features , access and benefit sharing.

### **Lecture Schedule**

1. Meaning, concepts and historical developments of Intellectual Property Rights.
2. Introduction to GATT, WTO, TRIPS and WIPO - role and importance
3. Treaties for IPR protection: Madrid Protocol, Berne Convention, Budapest Treaty, etc.
4. Types of IP and legislations covering IPR in India.
5. Patents, copy rights, trademark, industrial design,
6. Geographical indication and its importance, integrated circuits, trade secrets.
7. Patents Act 1970, Patent systems in India, patentability, process and product patent, filing of patent.
8. Patent specifications, patent claims, patent opposition and revocation, infringement.
9. Mid semester Examination.

10. Compulsory licensing, Patent Cooperation Treaty, patent search and patent data base.
11. Origin, history including a brief introduction to UPOV .
12. Protection of plant varieties under UPOV and PPV & FR Act of India.
13. Plant Breeders rights, registration of plant varieties under PPV & FR Act 2001, breeders, researcher and farmers rights.
14. Traditional knowledge - meaning and rights of TK holders and IPR.
15. Convention on Biological Diversity, International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA),
16. Indian Biological Diversity Act, 2002 and its salient features, access and benefit sharing.
17. Research collaborations in agriculture and role of IPR in protecting public institute inventions.

**Note : Lecture No. 1 to 10 ( Unit 1, 2 & 3 ) to be handled by Agricultural Economics Department and from 11 to 17 ( Unit 4 & 5 ) to be handled by Genetics and Plant Breeding Department. The course may be numbered as UGS as team teaching one.**

**Books , Acts and suggested readings :**

1. Vinod V. Sople, 2014, Managing intellectual Property : The Strategic imperative. PHI Learning Private Limited , N.Delhi
2. Acharya, N.K, Textbook of Intellectual Property Rights, 2002, Asia Law House , Hyderabad.
3. Keith, E. Maskus,2000, Intellectual Property Rights in Global Economy, Institute for International Economics.
4. Jennewein, Klaus,2004, Intellectual Property Management, Springer Verlag ,US
5. Erbisck FH and Maredia k . 1998 Intellectual Properties in Agricultural Bio technology.CABI
6. Ganguli P. 2001.Intelectual Property Rights : Unleashing Knowledge Economy .McGraw hill.
7. Ministry of Agriculture ,GOI 2004.State of Indian Farmer. Vol. V Technology generations and IPR issues. Academic Foundation.
8. Rothschild M and Scott N (Ed).2003. Intellectual Property Rights in Animal Breeding and Genetics . CABI.
9. Saha R (Ed). 2006 . Intellectual Property Rights in NAM and other developing countries. A Compendium on Law and Policies. Daya Pub. House.
10. Indian Acts- Patents Act 1970 and amendments; Design Act, 2000;Trademarks Act 1999;Copy rights Act,1957; Layout design Act 2000;PPV and FR Act,2001,and rules 2003;National Bio Diversity Act, 2003.

**Outcomes:**

- In-depth understanding of Energy contribution in agricultural sector, biomass utilization and importance of biofuels
- Understanding production and application of biogas, Solar and Wind energy

**Theory:****Unit I: Energy scenario**

Energy - energy unit conversion - energy crisis - Indian energy scenario - classification of energy sources - contribution of these sources in agricultural sector - significance - potential and achievements in India.

**Unit II: Biomass and biofuels**

Biomass - methods of energy conversion - Familiarization with biomass utilization for biofuel production and their application. Biochemical conversion methods- bioalcohol and bio ethanol production from wood and sugar substrates - effect of different parameters on ethanol production - application in agriculture. Bio-fuels - importance - biodiesel - chemistry of biodiesel production - production methods - flowchart - by products and their utilization as bioenergy resource - advantages and applications. Thermochemical conversion methods - chemistry of gasification - gasifier - types of gasifier - working principle - operation - applications- biooil.

**Unit III: Biogas**

Biogas - science of production of biogas - feed stocks used - properties of feed stock - factors affecting biogas production - capacity determination. Biogas plant - Familiarization with types of biogas plants - KVIC - Janata - Deenbandhu model biogas plant - construction and working principles - application of biogas - Bio-digested slurry

**Unit IV: Solar Energy**

Introduction to Solar energy - solar radiation - types of solar radiation - instrument for measuring solar radiation - collection and their application - solar constant - Familiarization with solar energy gadgets: solar cooker, solar water heater, application of solar energy: solar collector - types of solar collector - solar drying, solar photovoltaic system and their application - advantages and limitations - solar water pumping - working principle - advantages and applications - solar lantern. Solar pond - types of solar pond - solar distillation - working principles and applications.

**Unit V: Wind energy**

Introduction to wind energy and their application - Wind mills - types - components - working principles - applications, advantages and disadvantages of wind mill.

**Practical:**

Familiarization with renewable energy gadgets. To study biogas plants, To study gasifier, To study the production process of biodiesel, To study briquetting machine, To study the production process of bio-fuels. Familiarization with different solar energy gadgets. To study solar photovoltaic system: solar light, solar pumping, solar fencing. To study solar cooker, To study solar drying system. To study solar distillation and solar pond.

**Lecture schedule:**

1. Energy - energy unit conversion - energy crisis - Indian energy scenario - classification of energy sources
2. Contribution of energy sources in agricultural sector - significance - potential and achievements in India
3. Biomass - methods of energy conversion - Familiarization with biomass utilization for biofuel production and their application.
4. Biochemical conversion methods - fermentation and anaerobic digestion - bioalcohol - principle of production of bio ethanol from wood and sugar substrates - effect of different parameters on ethanol production - application in agriculture
5. Bio-fuels – importance. Biodiesel - chemistry of biodiesel production - transesterification - production methods – flow chart - byproducts and their utilization as bioenergy resource - advantages and applications.
6. Thermochemical conversion methods - combustion - pyrolysis - gasification - chemistry of gasification - gasifier - types of gasifier - working principle - operation – applications – Biooil.
7. Biogas - science of production of biogas - anaerobic digestion - feed stocks used - properties of feed stock - factors affecting biogas production - capacity determination.
8. Biogas plant - types of biogas plant - KVIC - Janata - Deenbandhu model biogas plant - construction and working principles - application of biogas - Biodigested slurry
- 9. MID SEMESTER EXAMINATION**
10. Introduction to-solar energy - solar radiation - characteristics of solar radiation -types of solar radiation - instruments for measuring solar radiation - collection and their application - solar constant - availability of solar radiation.
11. Familiarization with solar energy gadgets for collection and storage of solar radiation - solar collector - types of solar collector. Solar water heater - components - types of solar water heater - working principle applications - solar cooker - working principles and merits and demerits.
12. Drying - solar drying - solar air heater - solar dryer - classification of solar dryer - natural and forced convection type solar dryer.
13. Solar PV systems - applications, advantages and limitations - solar water pumping - working principle - advantages and applications - solar lantern.
14. Solar pond - types of solar pond - solar distillation - working principles and applications.
15. Wind energy - Energy available in wind - WECS - components of WECS - wind power transmission - controls - applications.
16. Wind mills – types of wind mill - working principle - applications - advantages and disadvantages of wind mill.

**Practical schedule:**

1. Study of basic principles of working of renewable energy gadgets
2. Study of production process of biodiesel.
3. Study of production process of bio fuel - bioethanol.
4. Study of working principle of KVIC biogas plant.
5. Study of working principle of deenbandhu biogas plant.
6. Study of different types of agro residue gasifier.
7. Study of different types of briquetting machines.
8. Study of different solar energy gadgets.
9. Study of solar drying systems.
10. Study of solar cookers.
11. Study of distillation.
12. Study of solar pond
13. Study of solar street light and solar lantern.
14. Study of solar fencing.
15. Study of solar PV system - solar water pumping
16. Study of different types of wind mills.
17. **FINAL PRACTICAL EXAMINATION**

**References:**

1. G.D. Rai. 2012. Nonconventional Energy Sources. Khanna Publishers, New Delhi.
2. C.S. Solanki, 2009. Renewable Energy Technologies : A Practical Guide for Beginners. PHI Learning Pvt. Ltd., New Delhi.
3. S. Rao and B.B. Parulekar. 2007. Energy Technology: Non-Conventional, Renewable and Conventional. Khanna Publishers, Naisarak, Delhi.
4. G.D. Rai. 1993. Solar Energy Utilisation. Khanna Publishers, New Delhi.
5. J. F. Manwell, J. G. McGowan and A. L. Rogers. 2009. Wind Energy Explained: Theory, Design and Application. Wiley & Sons Ltd.,

**AEN 301 PESTS OF CROPS AND STORED GRAINS AND THEIR MANAGEMENT (2+1)****Outcomes:**

- In-depth understanding Distribution, bionomics, symptoms of damage and management strategies for insects and non-insect pests of rice, grams, cotton and sugarcane, green manures.
- Understanding Distribution, bionomics, symptoms of damage and management strategies for insects and non-insect pests of fruits, vegetables, flowers, Coconut, Tea, Coffee, spices products and Curry leaf stored products.
- Understanding agricultural importance and management of Rodent, birds and Locusts



## **Theory**

**Unit-I:** Distribution, bionomics, symptoms of damage and management strategies for insects and non-insect pests of rice, wheat, maize, sorghum, cumbu, ragi, tenai, redgram, green gram, black gram, bengal gram, cowpea, groundnut, castor, gingelly, sunflower, safflower, jatropha, soybean and mustard.

**Unit-II:** Distribution, bionomics, symptoms of damage and management strategies of insects and non-insect pests of cotton and sugarcane, green manures (Sunnhemp, Sesbania, Daincha, Glyricidia), forage crops (Lucerne and Subabul)

**Unit-III:** Distribution, bionomics, symptoms of damage and management strategies of insect and non insect pests of Brinjal, Bhendi, Tomato, Chillies, Onion, Garlic, Moringa, Amaranthus, Crucifers, Cucurbits, Mango, Citrus, Banana, Guava, Grapevine and Sapota

**Unit-IV:** Distribution, bionomics, symptoms of damage and management strategies of insect and non insect pests of Pomegranate, Papaya, Aonla, Apple, Pine apple, Custard apple and Jack, Potato, Sweet potato, Tapioca, Yam, Colocasia, Coconut, Arecanut, Tea, Coffee, Cashew, Cocoa, Betelvine, Ginger, Turmeric, Coriander, Cardamom, Pepper, Curry leaf and Tamarind

**Unit -V:** Distribution, bionomics, symptoms of damage and management strategies of insect and non insect pests of Rose, Jasmine, Crossandra, Chrysanthemum, Tuberose, Cut flowers, Glory lily, Coleus, Stonebreaker, Aswagantha, Senna, Periwinkle and Lawn. Distribution, bionomics, symptoms of damage and management strategies of pests of and stored products. Rodents and birds of agricultural importance and their management. Locusts and their management.

## **Practical**

Identification of symptoms of damage and life stages of important pests of different field crops *vi.*, cereals, millets, pulses, oilseeds, cotton, sugarcane and green manure crops and horticultural crops *viz.*, vegetables, fruits, spices, tubers, plantation crops, flower crops, medicinal plants, lawn and stored products.

## **Lecture schedule:**

Distribution, bionomics, symptoms of damage and management strategies for insects and non-insect pests of

1. Rice – Sucking pests
2. Rice – Borers and defoliators
3. Maize, sorghum and cumbu
4. Wheat, ragi and tenai
5. Redgram, bengalgram, blackgram, greengram and cowpea
6. Groundnut, gingelly and sunflower

7. Castor, soybean, safflower, jatropha and mustard
8. Cotton – Sucking pests
9. Cotton – Bollworms, borers and defoliators
10. Sugarcane
11. Green manures and forage crops - sunnhemp, sesbania, daincha, lucerne, subabul and glyricidia
12. Brinjal, bhendi and tomato
13. Chillies, onion, garlic, moringa and amaranthus
14. Crucifers
15. Cucurbits
16. Mango
17. **Mid semester**
18. Citrus and banana
19. Guava, grapevine and sapota,
20. Pomegranate, papaya and aonla
21. Apple, pine apple, custard apple and jack
22. Potato, sweet potato, tapioca
23. Coconut and arecanut
24. Tea and coffee
25. Cashew, cocoa and betelvine
26. Ginger, turmeric and coriander,
27. Cardamom, pepper, curry leaf and tamarind
28. Rose, jasmine, crossandra, chrysanthemum, tuberose and cut flowers Glory lily, coleus, stone breaker, aswagantha, senna, periwinkle and lawn
29. Role of physical, biological, mechanical and chemical factors in deterioration of grain by Stored product pests
30. Stored product pests and their management
31. Locusts and their management
32. Rodents and birds of agricultural importance and their management

**Practical schedule: Identification of symptoms of damage and life stages of pests of**

1. Pests of rice
2. Pests of maize, sorghum , cumbu, ragi and tenai
3. Pests of pulses
4. Pests of groundnut, gingelly sunflower and castor
5. Pests of cotton
6. Pests of sugarcane
7. Pests of brinjal, bhendi and tomato
8. Pests of chillies, onion, garlic, moringa and amaranthus
9. Pests of crucifers and cucurbits
10. Pests of mango, citrus, sapota, banana, grapevine and guava
11. Pests of pomegranate, aonla, papaya, jack, pine apple, custard apple, ber and apple
12. Pests of potato, sweet potato and tapioca

13. Pests of coconut , cashew, cocoa , betelvine , coffee and tea
14. Pests of turmeric, ginger, coriander, cardamom, pepper and curry leaf
15. Pests of rose, jasmine, crossandra, chrysanthemum and tuberose
16. Pests of stored products
17. **Practical exam**

## References:

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4. <http://www.nrcg.res.in/>
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**AEX 301 COMMUNICATION AND PERSONALITY DEVELOPMENT (1+1)****Outcomes:**

- In-depth understanding of communication and personality.
- Understanding significance of Attitude, Self Motivation, Self Esteem, Time and Stress management

**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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**Outcomes:**

- Each student will be allotted a minimum land area of 100/200 m<sup>2</sup> and he / she will do all field operations in the allotted land from field preparation to harvest and processing.
- Field preparation, seed, treatment, nursery raising, sowing, nutrient, water and weed management and management of insect-pests diseases of crops, harvesting, threshing, drying winnowing, storage and marketing of produce.
- Any irrigated upland crop (maize / sorghum / pearl millet / finger millet / cotton / groundnut / sunflower / sesame/ greengram / blackgram etc.).

**Practical Schedule for Irrigated upland crop (e.g. Maize):**

- Ecosystem - Climate and weather - Seasons and varieties of India.
- Selection of field - Main field preparation - seed treatment - Application of manures and fertilizers - Sowing - Weed management and practicing pre- emergence application of herbicides - Thinning and gap filling - Estimation of plant population - Top dressing - Weed management - Water management - Pest management - Observation on nutrient and weeds - Recording growth, yield attributes and yield
- Harvesting, threshing and cleaning the produce - Cost of cultivation and economics.

**Practical schedule**

1. Selection of field for ID crop cultivation
2. Acquiring skill in seed treatment practices
3. Study and practice of main field preparation for ID crop
4. Practicing of application of manures and fertilizers for ID crop
5. Practicing sowing of ID crop/ exposure to mechanized sowing
6. Acquiring skill in pre-emergence application of herbicides
7. Estimation of plant population and acquiring skill in gap filling and thinning
8. Observation on nutritional deficiency symptoms and corrective measures
9. **MID-SEMESTER EXAMINATION**
10. Study of weeds and weed management in ID crop/ exposure to mechanized weeder
11. Recording growth parameters and assessing dry matter production
12. Study of water management practices for ID crop
13. Observation of insect pests and diseases and their management
14. Estimation of yield and yield parameters in ID crop
15. Harvesting, threshing and cleaning of the produce/ exposure to mechanized harvesting and threshing.
16. Preparation of balance sheet including cost of cultivation and net returns per student
17. **FINAL PRACTICAL EXAMINATION**

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1. Ahlawat, I.P.S., Om Prakash and G.S.Saini.2010. Scientific Crop Production in India. Rama Publishing House, Meerut.
2. Crop Production Guide. 2012. Directorate of Agriculture, Chennai and Tamil Nadu agricultural University, Coimbatore.
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4. Chidda Singh.1997. Modern techniques of raising field crops. Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi. Crop Production Guide. 2012. Directorate of Agriculture, Chennai and Tamil Nadu Agricultural University, Coimbatore.

## E-References:

[www.cimmyt.org](http://www.cimmyt.org)

## **AGR 302 CROP PRODUCTION TECHNOLOGY-II (*RABI* CROPS) (2+1)**

### Outcomes:

- In-depth understanding Origin, geographical distribution, soil and climatic requirements, varieties, cultural practices and yield of Cereals, Pulses, Oil Seeds.
- Understanding Origin, geographical distribution, soil and climatic requirements, varieties, cultural practices and yield of Sugar crops and Forage crops

### Theory:

Origin, geographical distribution, economic importance, soil and climatic requirements, varieties, cultural practices and yield of

#### **Unit I: Cereals**

Wheat, Barley, Oats and Rye

#### **Unit II: Pulses**

Chickpea, Lentil, Peas and French bean

#### **Unit III: Oil seeds**

Rapeseed, Mustard, Sunflower, Safflower and Linseed

#### **Unit IV: Sugar crops**

Sugarcane, Sugarbeet and sweet Sorghum

#### **Unit V: Forage crops**

Fodder oats, guinea grass, cenchrus, berseem, lucerne, hedge lucerne and desmodium



**Practical:**

Sowing methods of wheat and sugarcane, identification of weeds in *rabi* season crops, study of morphological characteristics of *rabi* crops, study of yield contributing characters of *rabi* season crops, yield and juice quality analysis of sugarcane, study of important agronomic experiments of *rabi* crops at experimental farms. Study of *rabi* forage experiments, visit to research stations of related crops.

**Theory schedule:**

1. Importance, area, production and productivity of rabi cereals.
2. Wheat - Origin - geographical distribution - economic importance - soil and climatic requirements – varieties
3. Wheat - Cultural practices: Field preparation – Season - Sowing – Water management – Weed management – Nutrient management – Harvesting – Yield
4. Barley - Origin - geographical distribution - economic importance - soil and climatic requirements – varieties - Cultural practices: Field preparation – Season - Sowing – Water management – Weed management – Nutrient management – Harvesting – Yield
5. Oats - Origin - geographical distribution - economic importance - soil and climatic requirements – varieties - Cultural practices: Field preparation – Season - Sowing – Water management – Weed management – Nutrient management – Harvesting – Yield
6. Rye - Origin - geographical distribution - economic importance - soil and climatic requirements – varieties - Cultural practices: Field preparation – Season - Sowing – Water management – Weed management – Nutrient management – Harvesting – Yield
7. Importance, area, production and productivity of rabi pulses.
8. Chick pea - Origin - geographical distribution - economic importance - soil and climatic requirements – varieties.
9. Chick pea - Cultural practices: Field preparation – Season - Sowing – Water management – Weed management – Nutrient management – Harvesting – Yield
10. Lentil - Origin - geographical distribution - economic importance - soil and climatic requirements – varieties - Cultural practices: Field preparation – Season - Sowing – Water management – Weed management – Nutrient management – Harvesting – Yield
11. Peas - Origin - geographical distribution - economic importance - soil and climatic requirements – varieties - Cultural practices: Field preparation – Season - Sowing – Water management – Weed management – Nutrient management – Harvesting – Yield
12. French bean - Origin - geographical distribution - economic importance - soil and climatic requirements – varieties - Cultural practices: Field preparation – Season - Sowing – Water management – Weed management – Nutrient management – Harvesting – Yield
13. Importance, area, production and productivity of rabi oilseeds.
14. Rape seed and Mustard - cultivated species - Origin - geographical distribution - economic importance - soil and climatic requirements – varieties.
15. Rape seed and Mustard - Cultural practices: Field preparation – Season - Sowing – Water management – Weed management – Nutrient management – Harvesting – Yield

16. Safflower - Origin - geographical distribution - economic importance - soil and climatic requirements –varieties - Cultural practices: Field preparation – Season - Sowing – Water management – Weed management – Nutrient management – Harvesting – Yield

#### **17. MID SEMESTER EXAMINATION**

18. Linseed - Origin - geographical distribution - economic importance - soil and climatic requirements –varieties - Cultural practices: Field preparation – Season - Sowing – Water management – Weed management – Nutrient management – Harvesting – Yield

19. Importance, area, production and productivity of sugar crops in India.

20. Sugar cane - Origin – Cultivated species - geographical distribution - economic importance - soil and climatic requirements –varieties

21. Sugar cane - Cultural practices: Field preparation – Season - Sowing – Water management – Weed management – Earthing up - Nutrient management – Detrashing and propping - Harvesting – Yield

22. Sugar cane – Seed production, SSI, Processing of cane to sugar and jiggery.

23. Sugarcane – Ratooning and ratoon crop management

24. Sugar beet - Origin - geographical distribution - economic importance - soil and climatic requirements –varieties - Cultural practices: Field preparation – Season - Sowing – Water management – Weed management – Nutrient management – Harvesting – Yield

25. Sweet sorghum - Origin - geographical distribution - economic importance - soil and climatic requirements –varieties - Cultural practices: Field preparation – Season - Sowing – Water management – Weed management – Nutrient management – Harvesting – Yield

26. Importance, area, production and productivity of rabi fodders.

27. Fodder oats - Origin - geographical distribution - economic importance - soil and climatic requirements – varieties - Cultural practices: Field preparation – Season - Sowing – Water management – Weed management – Nutrient management – Harvesting – Yield

28. Guinea grass and Cenchrus - Origin - geographical distribution - economic importance - soil and climatic requirements – varieties - Cultural practices: Field preparation – Season - Sowing – Water management – Weed management – Nutrient management – Harvesting - Yield

29. Cluster bean - Origin - geographical distribution - economic importance - soil and climatic requirements – varieties - Cultural practices: Field preparation – Season - Sowing – Water management – Weed management – Nutrient management – Harvesting – Yield

30. Berseem - Origin - geographical distribution - economic importance - soil and climatic requirements – varieties - Cultural practices: Field preparation – Season - Sowing – Water management – Weed management – Nutrient management – Harvesting – Yield

31. Lucerne - Origin - geographical distribution - economic importance - soil and climatic requirements – varieties - Cultural practices: Field preparation – Season - Sowing – Water management – Weed management – Nutrient management – Harvesting – Yield

32. Hedge lucerne and Desmodium - Origin - geographical distribution - economic importance - soil and climatic requirements – varieties - Cultural practices: Field

preparation – Season - Sowing – Water management – Weed management – Nutrient management – Harvesting – Yield

### **Practical Schedule:**

1. Identification of seeds of *rabi* crops
2. Study of methods of sowing of *rabi* crops
3. Study of different methods of planting of Sugarcane
4. Acquiring skill on different seed treatment techniques in *rabi* crops
5. Layout and raising of crop cafeteria
6. Study of morphological characteristics of *rabi* crops
7. Identification of weeds in *rabi* crops
8. Acquiring on intercultural operations in *rabi* crops
9. Acquiring skill on top dressing and foliar application of nutrients
10. Recording of bio-metric observations of the standing *rabi* crops.
11. Study of yield contributing characters of *rabi* crops.
12. Estimation of theoretical yield for *rabi* crops.
13. Working out economics of cultivation of *rabi* crops
14. Visit to forage production farm
15. Study of important agronomic experiments of *rabi* crops at experimental farms
16. Visit to research stations of *rabi* crops
- 17. FINAL PRACTICAL EXAMINATION**

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2. Singh. S.S. 1997. Crop management under irrigated and rainfed conditions. Kalyani Publishers, New Delhi
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### **AGR 303 RAINFED AGRICULTURE AND WATERSHED MANAGEMENT (1 + 1)**

#### **Outcomes:**

- Understanding the significance and scope of Rain fed agriculture and management strategies for drought and water shed.
- In-depth understanding the principle, techniques and types of soil and water conservation, water harvesting.

#### **Theory:**

##### **Unit I : Rain fed agriculture**

Rainfed agriculture – introduction and definition –Dry farming and rainfed farming: Characteristics. Significance and scope of dry farming in India –History of rainfed agriculture and watersheds in India. Problems and prospects of rainfed agriculture in India – Soil and climatic conditions prevalent in rainfed areas.

##### **Unit II: Drought**

Drought – types, effect of water deficit on physio- morphological characteristics of the plants, Mechanism of crop adaptation under moisture deficit condition; Management strategies for drought.

##### **Unit III: Soil and water conservation**

Soil erosion – definition – losses due to erosion – types of water and wind erosion – factors affecting erosion – Agronomic measures, mechanical measures and *In-situ* moisture conservation measures of soil and water conservation

#### **Unit IV: Water harvesting**

Water harvesting – importance and its techniques – Water harvesting structures – Storage and recycling – Efficient utilization of water through soil and crop management practices – Management of crops in rainfed areas – Contingent crop planning for aberrant weather conditions – mid season correction.

#### **Unit V: Water shed**

Watershed – concept - objectives – principles and components of watershed development programme – factors affecting watershed management. Non-monetary inputs and low cost technologies for crop production.

##### **Practical:**

Studies on climate classification, studies on rainfall pattern in rainfed areas of the country and pattern of onset and withdrawal of monsoons. Studies on cropping pattern of different rainfed areas in the country and demarcation of rainfed area on map of India. Interpretation of meteorological data and scheduling of supplemental irrigation on the basis of evapo-transpiration demand of crops. Critical analysis of rainfall and possible drought period in the country, effective rainfall and its calculation. Studies on cultural practices for mitigating moisture stress. Characterization and delineation of model watershed. Field demonstration on soil & moisture conservation measures. Field demonstration on construction of water harvesting structures. Visit to rainfed research station/watershed

#### **Lecture Schedule:**

1. Rainfed agriculture – introduction and definition –Dry farming and rainfed farming: Characteristics. Significance and scope of dry farming in India
2. History of rainfed agriculture and watersheds in India.
3. Problems and prospects of rainfed agriculture in India – climate – rainfall pattern – distribution – variabilities of rainfall
4. Soil and climatic conditions prevalent in rainfed areas.
5. Drought – definition – types of drought – effect of water deficits on physio-morphological characteristics of the plants- mechanism of crop adaptation under drought
6. Management strategies for drought – measures to reduce evapotranspiration – weeding, use of mulches, anti transpirants , windbreaks and shelterbelts
7. Soil erosion – definition – losses due to erosion – types of water and wind erosion – nature and extent of wind and water erosion – factors affecting erosion – universal soil loss equation
8. Agronomic measures of soil and water conservation – choice of crop – crop geometry – tillage – contour cultivation – strip cropping – cover cropping – mulching – cropping systems and weed control
9. **MID-SEMESTER EXAMINATION**

10. Mechanical measures of soil and water conservation – gully control – bench terraces – contour contour bunds – graded bunds
11. *In-situ* moisture conservation measures – bund forming – bunding, ridge and furrow system – conservation furrows – inter plot water harvesting, mulching – Broad Bed and Furrow (BBF) and Zero tillage.
12. Water harvesting – importance and its techniques – Water harvesting structures – Storage and recycling
13. Efficient utilization of water through soil and crop management practices – Management of crops in rainfed areas
14. Contingent crop planning for aberrant weather conditions – mid season correction.
15. Watershed: concept - objectives – principles and components of watershed development programme – factors affecting watershed management.
16. Non-monetary inputs and low cost technologies for crop production.

#### **Practical schedule:**

1. Climate classification.
2. Rainfall pattern in rainfed areas of the country and pattern of onset and withdrawal of monsoons.
3. Cropping pattern of different rainfed areas of India
4. Mapping of rainfed areas in India.
5. Interpretation of meteorological data for rainfall variability.
6. Scheduling of supplemental irrigation based on crop ET demand.
7. Critical analysis of rainfall and calculation of wet spells, dry spells and length of growing period.
8. Calculation of effective rainfall.
9. Drought management technologies in dryland agriculture
10. Soil & moisture conservation measures.
11. Water harvesting structures
12. Characterization and delineation of model watershed
13. Cropping and farming systems in drylands.
14. Mechanization in dryland farming.
15. Alternate land use system
16. Visit to watershed / rainfed research station.
17. **FINAL PRACTICAL EXAMINATION**

#### **References:**

1. Reddy, S. R. and Prabhakara Reddy, G. 2015. Dryland Agriculture. Kalyani Publishers.
2. Arnon, I. 1972. Crop Production in Dry Regions (Vol.I), Leonard Hill Pub. Co, London.
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**HOR 311**

**PRODUCTION TECHNOLOGY OF FRUIT AND PLANTATION CROPS**

**1+1**

#### **Outcomes:**

- In-depth understanding the importance and classification of fruit crops.
- Understanding production technology of fruit crops and plantation crops.

#### **Theory**

##### **Unit-I: Importance and classification of fruits**

Importance and scope of fruit and plantation crop industry in India – nutritional value of fruit crops - classification of fruit crops – area, production, productivity and export potential of fruit and plantation crops.

##### **Unit-II: Production Technology of mango, banana, papaya, guava, sapota**

Climate and soil requirements – varieties – propagation and use of rootstocks- planting density and systems of planting - High density and ultra high density planting - cropping systems - after care - training and pruning - water, nutrient and weed management –fertigation - special horticultural techniques - plant growth regulation - important disorders – maturity indices and harvest- value addition. Fruit crops: mango, banana, papaya, guava, sapota.

##### **Unit-III: Production Technology of citrus, grape, litchi, pineapple, pomegranate, jackfruit**

Climate and soil requirements – varieties – propagation and use of rootstocks- planting density and systems of planting - High density and ultra high density planting - cropping systems - after care - training and pruning - water, nutrient and weed management – fertigation - special horticultural techniques - plant growth regulation - important disorders – maturity indices and harvest and value addition. Fruit crops: citrus, grape, litchi, pineapple, pomegranate, jackfruit.

##### **Unit-IV: Production Technology of apple, pear, peach, strawberry, almond, walnut**

Climate and soil requirements – varieties – propagation and use of rootstocks - planting density and systems of planting -High density and ultra high density planting -cropping systems - after care - training and pruning - water, nutrient and weed management –fertigation - special

horticultural techniques - plant growth regulation - important disorders – maturity indices and harvest and value addition. Fruit crops:apple, pear, peach, strawberry, almond, walnut

### **Unit-V: Production Technology of Plantation Crops**

Climate and soil requirements - varieties - propagation - nursery management - planting and – plantingsystems - cropping systems - after care - water, nutrient and weed management - intercropping - multi-tier cropping system - mulching - special horticultural practices - maturity indices, harvest and yield - processing - value addition. Palms:Coconut, Arecanut, Oil palm and Palmyrah. Plantation crops: Tea, Coffee, Cocoa, Cashew, Rubber

### **Practical**

Propagation methods for fruit crops - description and identification of varieties - preparation of plant bio regulators & their uses – nutrient deficiency and disorders of fruit crops - fertilizers- application - pests and diseases- micro propagation in fruit crops- Visit to commercial orchard. Fruit Crops: Mango, banana, papaya, guava, sapota, grapes, citrus (Mandarin and acid lime), pomegranate and jackfruit. Propagation methods for plantation crops - description and identification of plantation crops - preparation of plant bio regulators & their uses - nutritional disorders of plantation crops - fertilizers-application - pests and diseases- cost economics of plantation crops. Visit to plantations and plantation industries. Palms and plantation Crops: Coconut, Arecanut, Cashew, Tea, Coffee, Rubber and Cocoa

### **Lecture Schedule**

1. Importance and scope of fruit and plantation crop industry in India – nutritional value of fruit crops. Classification of fruit crops – area, production, productivity and export potential of fruit and plantation crops.
2. Climate and soil – varieties - propagation methods - planting and cropping systems - after care-training and pruning- top working - water, nutrient and weed management-canopy management - plant growth regulation - important disorders – maturity indices and harvest - post harvest management of Mango.
3. Climate and soil – varieties - propagation methods - planting and cropping systems - after care-water and nutrient management – fertigation - Weed control - Plant growth regulation - important disorders – maturity indices and harvest- post harvest management of Banana.
4. Climate and soil – varieties - propagation methods - planting and cropping systems - after care – water, nutrient and weed management - crop regulation- important disorders – maturity indices and harvest - post harvest management of Papaya, Guava and sapota.
5. Climate and soil – varieties - propagation methods - planting and cropping systems - after care - water, nutrient and weed management - crop regulation – nutrient deficiencies and important disorders – maturity indices and harvest- post harvest management of Citrus (Sweet orange,Mandarin and Acid Lime).
6. Climate and soil – varieties - propagation methods - planting and cropping systems- after care – systems of training and pruning and bud forecasting - water, nutrient and



weed management - plant growth regulation - important disorders – maturity indices and harvest - post harvest management of Grapes.

7. Climate and soil – varieties - propagation methods - planting and cropping systems - after care - water, nutrient and weed management - plant growth regulation- important disorders – maturity indices and harvest - post harvest management of pineapple and litchi.
8. Climate and soil – varieties - propagation methods - planting and cropping systems - after care - training and pruning - water, nutrient and weed management - plant growth regulation - important disorders – maturity indices and harvest - post harvest management of Pomegranate, jackfruit.
9. **MID SEMESTER EXAMINATION**
10. Climate and soil – varieties - propagation methods - planting and cropping systems - after care-training and pruning - water, nutrient and weed management - plant growth regulation - important disorders – maturity indices and harvest- post harvest management of Apple and Pear, Peach.
11. Climate and soil – varieties - propagation methods - planting and cropping systems - after care-training and pruning - water, nutrient and weed management - plant growth regulation - important disorders – maturity indices and harvest - post harvest management of Strawberry, Almond, Walnut.
12. Climate and soil requirements - varieties - propagation - nursery management - planting systems - planting density -nutrient, water and weed management - intercropping at various ages of plantation -multitier cropping - shade management - nutritional disorders - maturity indices - harvest and yield - grading - processing and value addition of Coconut.
13. Climate and soil requirements - varieties - propagation - nursery management - planting systems - planting density - nutrient, water and weed management - intercropping at various ages of plantation - multitier cropping – shade management - nutritional disorders - maturity indices - harvest and yield - grading - processing and value addition of Arecanut and Cocoa.
14. Climate and soil requirements - varieties - propagation - nursery management - planting and planting density - HDP - UHDP - nutrient, water and weed management - cover cropping - tapping - use of plant growth regulators - top working - maturity indices - harvest and yield , latex yield and processing - grading - processing and value addition Rubber and Cashew.
15. Climate and soil requirements- varieties – propagation - nursery management - planting density and systems of planting - nutrient, water and weed management - mulching - cropping systems - shade regulation - training and pruning - role of growth regulators - nutritional disorders - maturity indices - harvest and yield - grading - processing and value addition of Tea, Coffee.
16. Climate and soil requirements - varieties – propagation - nursery management - planting - nutrient, water and weed management - water conservation techniques - leaf pruning - pollination - maturity indices - harvest and yield - grading - processing and value addition Oil palm and Palmyrah.

### Practical schedule

1. Propagation techniques, selection of planting material, varieties, important cultural practices for Mango
2. Propagation techniques, selection of planting material, varieties, important cultural practices for Banana
3. Propagation techniques, selection of planting material, varieties, important cultural practices for Papaya
4. Propagation techniques, selection of planting material, varieties, important cultural practices for Guava
5. Propagation techniques, selection of planting material, varieties, important cultural practices for Sapota
6. Propagation techniques, selection of planting material, varieties, important cultural practices for Grapes
7. Propagation techniques, selection of planting material, varieties, important cultural practices for Citrus (Mandarin and acid lime)
8. Propagation techniques, selection of planting material, varieties, important cultural practices for Pomegranate
9. Propagation techniques, selection of planting material, varieties, important cultural practices for Jackfruit
10. Preparation and application of PGR's for propagation
11. Micro propagation, protocol for mass multiplication and hardening of fruit crops.
12. Identification and description of varieties – mother palm and seed nut selection – nursery practices – seedling selection – fertilizers – application – nutritional disorders – pests and diseases of coconut
13. Identification and description of varieties – mother palm and seed nut selection – nursery practices – fertilizers – application – nutritional disorders – pests and diseases of Arecanut and cocoa
14. Identification and description of varieties - nursery practices - training and pruning - pests and diseases – processing of Tea and coffee
15. Identification and description of varieties, clones - bud wood nursery practices - propagation techniques - top working – preparation of plant bio regulators and its uses- pests and diseases - processing of rubber and cashew
16. Visit to commercial orchard and plantation industries.
17. **PRACTICAL EXAMINATION**

### References

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- Chadha, K.L and Pareek, O.P. 1996. (Eds.). Advances in Horticulture. Vols. IIIIV. Malhotra Publ. House
- Kumar, N.2014. Introduction to Spices, Plantation, Medicinal and Aromatic crops, IBH Publishing Co.Pvt. Ltd., New Delhi.
- Alice Kurian and Peter, K.V. 2007. Horticulture science series Vol. 08, New India Publishing Agency, New Delhi.
- Veeraragavathatham, D. 2004. Scientific fruit culture, Suri Associates,Coimbatore.
- Henry Louis,I. 2002. Coconut- The wonder palm. Hi - Tech Coconut Corporation, Nagercoil

**Outcomes**

- Understanding Etiology, symptoms, mode of spread, survival, epidemiology, management, diseases of cereals and millets, pulses and oilseeds
- Understanding Etiology, symptoms, mode of spread, survival, epidemiology, management, diseases of cash, fruit, vegetables, plantation and medicinal crops

**THEORY**

Etiology, symptoms, mode of spread, survival, epidemiology and integrated management of important diseases of the following crops

**Unit I: Diseases of cereals and millets**

Cereals: Rice and maize - Millets: Sorghum, pearl millet, finger millet and small millets

**Unit II: Diseases of pulses and oilseeds**

Pulses: Pigeon pea, urd bean, mung bean, cowpea, soyabean - Oilseeds: Ground nut, castor and sesame - Diseases of stored grains

**Unit III: Diseases of cash crops and fruit crops**

Cash crops: Tobacco, jute and mulberry - Fruit crops: Banana, guava, sapota, papaya, pomegranate, pineapple, jack fruit, aonla and ber

**Unit IV: Diseases of vegetables crops**

Vegetable crops: Tomato, brinjal, okra, crucifers, beans, sweet potato, carrot and beetroot - Post harvest diseases of fruits and vegetables.

**Unit V: Diseases of plantation and medicinal crops**

Plantation crops: Coconut, arecanut, oilpalm, vanilla, tea, coffee, rubber and cocoa - Medicinal crops: Gloriosa, coleus, stevia and aloe

**PRACTICAL**

Study of symptoms and host parasite relationship of rice, maize, sorghum, pearl millet, finger millet, small millets, pigeon pea, urd bean, mung bean, cowpea, soyabean, ground nut, castor, sesame, tobacco, jute, mulberry, banana, guava, sapota, papaya, pomegranate, pineapple, jack, ber, aonla, tomato, brinjal, okra, crucifers, beans, sweet potato, carrot, beetroot, coconut, arecanut, oilpalm, vanilla, tea, coffee, rubber, cocoa, gloriosa, coleus, stevia and aloe.

**THEORY**

**Etiology, symptoms, mode of spread, survival, epidemiology and integrated management of**

1. Diseases of rice

2. Diseases of maize
3. Diseases of sorghum
4. Diseases of pearl millet and finger millet
5. Diseases of small millets
6. Diseases of pigeonpea
7. Diseases of urdbean, mungbean and cowpea
8. Diseases of soybean
9. Diseases of groundnut
10. Diseases of sesame and castor
11. Diseases of stored grains and their management
12. Diseases of tobacco
13. Diseases of jute and mulberry
14. Diseases of banana
15. Diseases of guava, papaya and sapota
16. Diseases of pomegranate and pineapple
- 17. Mid semester examination**
18. Diseases of jack fruit, ber and aonla
19. Diseases of crucifers
20. Diseases of tomato
21. Diseases of brinjal and okra
22. Diseases of sweet potato and beans
23. Diseases of carrot and beetroot
24. Diseases of coconut
25. Diseases of arecanut and oilpalm
26. Diseases of vanilla
27. Diseases of tea
28. Diseases of coffee
29. Diseases of rubber
30. Diseases of cocoa
31. Diseases of gloriosa, coleus, stevia and aloe
32. Post-harvest diseases of fruits and vegetables

## **PRACTICAL**

### **Study of symptoms and host-parasite relationship of:**

1. Diseases of rice
2. Diseases of maize and sorghum
3. Diseases of pearl millet, finger millet and small millets
4. Diseases of pigeonpea, urdbean, mungbean, soybean and cowpea
5. Diseases of groundnut, sesame and castor
6. Diseases of tobacco, jute and mulberry
7. Diseases of banana, papaya, pomegranate
8. Diseases of guava, sapota, pineapple, jack fruit, ber and aonla
9. Diseases of crucifers

10. Field visit/ exposure visit to fruits, vegetables and plantation crops
11. Diseases of tomato, brinjal and okra
12. Diseases of sweet potato, beans, carrot and beetroot
13. Diseases of coconut, arecanut, oilpalm and vanilla
14. Diseases of tea and coffee
15. Diseases of rubber and cocoa
16. Diseases of gloriosa, coleus, stevia and aloe
17. Final practical examination

#### **Reference Books**

1. Arjunan.G. Karthikeyan, G, Dinakaran ,D. Raguchander,T. 1999 Diseases of Horticultural Crops, AE Publications, Coimbatore.
2. Rangasawmi ,G and Mahadevan, A. 1998. Diseases of crop Plants in India, Prentice Hall of India Pvt. Ltd., New Delhi
3. Prakasam, V., Valluvaparidasan, V., Raguchander, T. and K.Prabakar. 1997. Field crop diseases, AE Publication, Coimbatore.
4. Agrios, G.N. 2008. Plant Pathology, Academic Press, New York.
5. Rangaswami, G. 2005. Diseases of Crop plants in India. Prentice Hall of India Pvt. Ltd., New Delhi.
6. Thakur, B.R. 2006. Diseases of field crops and their management

#### **e- References**

1. [www.plantdisease.com](http://www.plantdisease.com)
2. [www.apsnet.org](http://www.apsnet.org)
3. [www.ipm.ucdavis.edu](http://www.ipm.ucdavis.edu)
4. [www.nhb.gov.in](http://www.nhb.gov.in)
5. [www.umain.edu](http://www.umain.edu)
6. [www.farmers.gov.in](http://www.farmers.gov.in)
7. [www.nrcb.res.in](http://www.nrcb.res.in)

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

### **Outcomes:**

- In-depth understanding the history of soil fertility and plant nutrition, chemistry of soil nutrients and fertilizers.
- Understanding the importance of organic manures and nutrient managements

### **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, phosphoric, potassic fertilizer. Secondary and micronutrient fertilizers. Manufacture of urea, ammonium sulphate, ammonium nitrate, single super 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 industrial wastes. Carbon sequestrations and carbon trading.

#### **Unit-V: Nutrient Management**

Concepts of Nutrient management. Integrated Nutrient 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. Fertilization. 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.

### **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, pelletization, seedlings dipping and nutri-seed pack.
30. Fertigation – Definition and types of fertigation, 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. Soil nutrient analysis – Estimation of organic carbon in soil
2. Estimation of Available N status in soil
3. Estimation of Available P status in soil
4. Estimation of Available K and S status in soil
5. DTPA extractable micronutrients 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<sub>2</sub>SO<sub>4</sub>
12. Manure analysis – Estimation of N in FYM / Compost/Green manures
13. Estimation 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.**

### **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](http://www.fspublishers.org/ijab/past-issues/IJABVOL_5_NO_3/47.pdf)
2. [www.springerlink.com/index/I011256h8t325054.pdf](http://www.springerlink.com/index/I011256h8t325054.pdf)
3. [www.ipni.net/ppiweb/bcrops.nsf/\\$webindex/.../Better\\_Crops\\_2009-4\\_L.pdf](http://www.ipni.net/ppiweb/bcrops.nsf/$webindex/.../Better_Crops_2009-4_L.pdf)
4. [onlinelibrary.wiley.com/doi/10.1002/9780470431771.index/pdf](http://onlinelibrary.wiley.com/doi/10.1002/9780470431771.index/pdf)
5. [agtr.ilri.cgiar.org/agtrweb/Documents/Library/docs/.../Module4.htm](http://agtr.ilri.cgiar.org/agtrweb/Documents/Library/docs/.../Module4.htm)
6. [www.uoa.edu.er/academics/graduate/.../courses.html](http://www.uoa.edu.er/academics/graduate/.../courses.html) -
7. [www.fao.org/wairdocs/ilri/x5546e/x5546e08.htm](http://www.fao.org/wairdocs/ilri/x5546e/x5546e08.htm)
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9. [www.uoa.edu.er/academics/graduate/.../courses.html](http://www.uoa.edu.er/academics/graduate/.../courses.html) -
10. [www.ncpahindia.com/articles/article17.pdf](http://www.ncpahindia.com/articles/article17.pdf) - Similar
11. [www.energy.ca.gov/process/agriculture/ag\\_pubs/fertigation.pdf](http://www.energy.ca.gov/process/agriculture/ag_pubs/fertigation.pdf) -
12. [www.soilandhealth.org/.../010117attraoilmanual/010117attra.html](http://www.soilandhealth.org/.../010117attraoilmanual/010117attra.html)
13. [goliath.ecnext.com/.../Deficiencies-in-the-soil-quality.html](http://goliath.ecnext.com/.../Deficiencies-in-the-soil-quality.html) –

## SEMESTER VI

Sl.No.	Course No.	Course Title	Cr.Hr.
1.	AEC 302	Agricultural Finance and Cooperation	2+1
2.	AEG 302	Protected Cultivation and Secondary Agriculture	1+1
3.	AEN 302	Management of Beneficial Insects	1+1
4.	AEX 302	Entrepreneurship Development and Business Management	1+1
5.	AGR 304	Practical Crop Production –II ( <i>Rabi</i> crops)	0+1
6.	AGR 305	Principles of Organic Farming	1+1
7.	FSN 301	Principles of Food Science and Nutrition	2+0
8.	GPB 301	Crop Improvement	2+1
9.	HOR 312	Post-harvest Management and Value Addition of Fruits and Vegetables	1+1
10	PAT 302	Diseases of Field and Horticultural Crops and their Management-II	2+1
11.	---	Elective Course-3	2+1
TOTAL			15+10=25

## **AEC 302 Agricultural Finance and Co-operation (2+1)**

### **Outcomes:**

- In-depth understanding about nature and scope of Agricultural Finance, Financial Institutions and Farm Financial Analysis.
- Understanding Co-operation, Banking and Insurance.

### **Theory**

#### **Unit 1: Agricultural Finance – Nature and Scope:**

Agricultural Finance- meaning, scope and significance, credit needs and its role in Indian agriculture. Agricultural credit: meaning, definition, need, classification. Sources of credit - advantages and disadvantages - Rural indebtedness- History and Development of rural credit in India.

#### **Unit 2: Financial Institutions:**

Sources of agricultural finance: institutional and non-institutional sources and their roles, commercial banks - social control and nationalization of commercial banks – AD branches – Area approach – Priority sector lending. Micro financing including KCC, Micro finance – SHG Models, Lead Bank Scheme, RRBs, Scale of finance and unit cost. Cost of credit. An introduction to higher financing institutions – RBI, NABARD, ADB, IMF, World Bank, Insurance and Credit Guarantee Corporation of India. Recent development in agricultural credit: Rural credit policies of Government – Subsidized farm credit - Differential Interest Rate (DIR) Scheme – Loan relief measures

#### **Unit 3: Farm Financial Analysis:**

Credit analysis: 3 R's, 7 P's and 5 C's of credit. Preparation of bankable projects / Farm credit proposals – Feasibility; Appraisal - Time value of money: Compounding and Discounting - Undiscounted and Discounted measures. Preparation and analysis of financial statements Balance Sheet, Income Statement and Cash Flow Statement. Basic guidelines for preparation of project reports - Bank norms – SWOT analysis.

#### **Unit 4: Co-operation:**

Agricultural Cooperation in India—Meaning, brief history of cooperative development in India - Pre and Post - Independence periods and Co-operation in different plan periods, objectives, principles of cooperation, significance of cooperatives in Indian agriculture. Co-operative credit structure: short term and long term. Agricultural Cooperation - credit, marketing, consumer and multi-purpose cooperatives, farmers' service cooperative societies, processing cooperatives, farming cooperatives, cooperative warehousing; role of ICA, NCUI, NCD, NAFED. Strength and weakness of co-operative credit system, Policies for revitalizing co-operative credit.

#### **Unit 5: Banking and Insurance:**

Negotiable Instruments: Meaning, Importance and Types - Central bank: RBI – functions - Credit control – Objectives and Methods: CRR, SLR and Repo rate - Credit rationing - Dear

money and cheap money. monetary policies. Credit gap: Factors influencing credit gap. Non - Banking Financial Institutions (NBFI). NPA – Causes, consequences and mitigation. Crop Insurance: Schemes, Coverage, Advantages and Limitations in Implementation. Weather based crop insurance, features, determinants of compensation. Livestock Insurance Schemes - Agricultural Insurance Company of India Ltd (AIC): Objectives and functions.

## **Practical**

Determination of most profitable level of capital use. Optimum allocation of limited amount of capital among different enterprise. Analysis of progress and performance of cooperatives using published data. Analysis of progress and performance of commercial banks and RRBs using published data. Visit to a commercial bank, cooperative bank / cooperative society to acquire first- hand knowledge of their management, schemes and procedures. Visit to District Central Co-operative Bank (DCCB) to study its role, functions and procedures for availing loan – Fixation of Scale of Finance. Estimation of credit requirement of farm business – A case study. Preparation and analysis of Balance Sheet, and Cash Flow Statement – A case study. Exercise on Financial Ratio Analysis. Appraisal of farm credit proposals – A case study. Preparation and analysis of income statement – A case study. Preparation of Bankable projects / Farm Credit Proposals and appraisal - Undiscounted methods and Discounted methods. Techno-economic parameters for preparation of projects for various agricultural products and its value added products. Seminar on selected topics. Analysis of Different Crop Insurance Products / Visit to crop insurance implementing agency.

## **Theory Schedule**

1. Agricultural Finance - meaning, scope and significance, credit needs and its role in Indian agriculture.
2. Agricultural credit: meaning, definition, need and classification.
3. Sources of credit - advantages and disadvantages.
4. Rural indebtedness - History and Development of rural credit in India.
5. Sources of agricultural finance: institutional and non-institutional sources - their roles.
6. Commercial banks - social control and nationalization of commercial banks.
7. Micro financing including KCC, Micro finance – SHG Models, Lead bank scheme.
8. RRBs, Scale of finance and unit cost. Cost of credit.
9. An introduction to higher financing institutions—RBI, NABARD, ADB, IMF and World Bank.
10. Role of Insurance and Credit Guarantee Corporation of India.
11. Recent developments in agricultural credit.
12. Rural credit policies of Government: Subsidized farm credit- Differential Interest Rate (DIR) Scheme— Loan relief measures
13. Credit analysis: 3 R's, 7 P's and 3C's of credit.
14. Preparation of bankable projects / Farm credit proposals – Feasibility.
15. Appraisal: Time value of money: Compounding and Discounting - Undiscounted and Discounted measures.
16. Preparation and analysis of financial statements – Balance Sheet, Income Statement and Cash Flow Statement.

### **17. Mid Semester Examination**

18. Basic guidelines for preparation of project reports- Bank norms – SWOT analysis.
19. Agricultural Cooperation in India – Meaning, brief history of cooperative development in India.
20. Pre and Post - Independence periods and Co-operation in different plan periods, objectives, principles of cooperation, significance of cooperatives in Indian agriculture.
21. Co-operating credit structure: short term and long term. Agricultural Cooperation - credit, marketing, consumer and multi-purpose cooperatives, farmers' service cooperative societies, processing cooperatives, farming cooperatives, cooperative warehousing;
22. Role of ICA, NCUI, NCDC and NAFED.
23. Strength and weakness of co-operative credit system, Policies for revitalizing co-operative credit.
24. Negotiable Instruments: Meaning, Importance and Types.
25. Central bank: RBI – functions, Credit control – Objectives and Methods: CRR, SLR and Repo rate.
26. Credit rationing - Dear money and cheap money.
27. Financial Inclusion and Exclusion: credit widening and credit deepening monetary policies.
28. Credit gap: Factors influencing credit gap.
29. Non - Banking Financial Institutions (NBFI). NPA – Causes, consequences and mitigation.
30. Crop Insurance and Livestock Insurance Schemes: Coverage, Advantages and Limitations in Implementation.
31. Weather based crop insurance, features, determinants of compensation.
32. Agricultural Insurance Company of India Ltd (AIC): Objectives and functions.

### **Practical Schedule**

1. Determination of most profitable level of capital use.
2. Optimum allocation of limited amount of capital among different enterprises.
3. Analysis of progress and performance of cooperatives using published data.
4. Analysis of progress and performance of commercial banks and RRBs using published data.
5. Visit to a commercial bank, cooperative bank / cooperative society to acquire first - hand knowledge of their management, schemes and procedures.
6. Visit to District Central Co-operative Bank (DCCB) to study its role, functions and procedures for availing loan – Fixation of Scale of Finance.
7. Guest lecture on Role and functions of Commercial Bank and Lead Bank / NABARD and its Role and Functions.
8. Estimation of credit requirement of farm business – A case study.
9. Preparation and analysis of Balance Sheet and Cash Flow Statement – A case study.
10. Exercise on Financial Ratio Analysis. Appraisal of farm credit proposals – A case study.
11. Preparation and analysis of income statement – A case study.
12. Preparation of Bankable projects / Farm Credit Proposals and appraisal.
13. Undiscounted methods and Discounted methods.
14. Techno-economic parameters for preparation of projects for various agricultural products and its value added products.
15. Analysis of Different Crop Insurance Products / Visit to crop insurance implementing agency.

16. Seminar on selected topics.

17. **Practical Examination.**

### **References**

1. Muniraj, R. 1987. Farm Finance for Development. Oxford & IBH. New Delhi.
2. Subba Reddy, S and P. Raghu Ram. 2011. Agricultural Finance and Management. Oxford & IBH. New Delhi.
3. Lee, W.F., M.D. Boehlje, A.G. Nelson and W.G. Murray. 1998. Agricultural Finance. Kalyani Publishers. New Delhi.
4. Mammoria, C.B. and R.D. Saxena. 1973. Cooperation in India. KitabMahal. Allahabad.
- Patnaik, V.E. and A.K. Roy. 1988. Cooperation and Cooperative Management. Kalyani Publishers. Ludhiana.

### **E-References:**

1. [www.pajancoa.ac.in](http://www.pajancoa.ac.in)
2. [www.tawn.tnau.ac.in](http://www.tawn.tnau.ac.in)
3. [www.usbr.gov/pn/agri.met](http://www.usbr.gov/pn/agri.met)

## **AEG 302 PROTECTED CULTIVATION AND SECONDARY AGRICULTURE (1+1)**

### **Outcomes:**

- In-depth understanding about protected cultivation, application and design of green houses.
- Understanding Engineering properties of food materials, Drying, dehydration and material handling.

### **Theory:**

#### **Unit I: Protected cultivation and design of green houses**

Protected cultivation - need, advantages and limitations - present status. Green house technology - introduction - types of greenhouses - plant response to greenhouse environment. Planning and design of greenhouses - design criteria of green house for cooling and heating purposes - green house equipments - materials for construction of traditional and low cost green houses- irrigation systems used in greenhouses.

#### **UNIT II: Applications of greenhouses**

Typical applications - passive solar greenhouse - hot air greenhouse heating systems - greenhouse drying - cost estimation and economic analysis.

#### **UNIT III: Engineering properties of food materials**

Important engineering properties: physical, thermal, aero and hydro dynamic mechanical, frictional, rheological and optical properties of cereals, pulses and oil seeds and their application in PHT equipment design and operation.

#### **UNIT IV: Drying and dehydration**

Drying and dehydration, moisture determination- direct method and indirect method of moisture determination. EMC - importance of EMC - drying theory - drying rate periods- constant rate period- falling rate period - CMC. Drying methods- contact type dryers- convective type dryer- radiation dryer. Commercial grain dryer - deep bed dryer, flat bed dryer, tray dryer, fluidized bed dryer, recirculatory dryer, LSU dryer and solar dryer - types of solar dryer.

#### **UNIT V: Material handling**

Material handling - material handling equipments- selection of material handling equipments. Belt conveyor- bucket elevator - screw conveyor - pneumatic conveyor - their working principle and selection - capacity - horse power - advantages and limitations.

##### **Practical:**

Study of different type of greenhouses based on shape. Determine the rate of air exchange in an active summer winter cooling system. Determination of drying rate of agricultural products inside green house. Study of greenhouse equipments. Visit to various Post Harvest Laboratories. Determination of moisture content of various grains by oven drying & infrared moisture methods. Determination of engineering properties (shape and size, bulk density and porosity of biomaterials). Determination of Moisture content of various grains by moisture meter. Field visit to seed processing plant.

##### **Lecture schedule:**

1. Introduction to protected cultivation - need, advantages and limitations and present status - green house technology - types of greenhouses
2. Plant response to greenhouse environment - sunlight, temperature, relative humidity, carbon dioxide enrichment - soil / media
3. Planning and design of greenhouses - design criteria of green house for cooling and heating purposes.
4. Green house equipments - materials for construction of traditional and low cost green houses - irrigation systems used in greenhouses.
5. Typical applications of greenhouses - passive solar greenhouse, hot air greenhouse heating system
6. Green house drying- cost estimation and economic analysis.
7. Important Engineering properties of cereals, pulses and oilseeds and their application in PHT equipment design and operation.
8. Physical properties – size - shape - sphericity - density - specific gravity. Mechanical properties – aero and hydrodynamic properties - terminal velocity - drag coefficient - application.
9. **MID SEMESTER EXAMINATION.**
10. Thermal properties- specific heat - thermal conductivity- thermal diffusivity - Frictional properties - angle of repose - angle of internal friction - optical and rheological properties- application
11. Drying and dehydration - moisture measurement, direct method and indirect methods of moisture measurements.

12. EMC - importance of EMC - drying theory- drying rate periods - constant rate period, falling rate period, CMC.
13. Drying methods - contact type dryers - convective type dryer- radiation dryer - Commercial grain dryers - thin layer dryer, deep bed dryer, flat bed dryer, tray dryer, fluidized bed dryer, recirculatory dryer, LSU dryer and solar dryer - types of solar dryer
14. Material handling - material handling equipments- selection of material handling equipments. Belt conveyor - idlers - idler spacing - belt material - belt tension-working principle and selection.
15. Bucket elevator - head section - boot section - elevator legs - elevator belts- bucket drive mechanism - working principle and selection.
16. Screw conveyor - details - various shapes screw trough - capacity - horse power, Pneumatic conveyor - working principle and selection. - advantages and limitations.

#### **Practical schedule:**

1. Study of different types of greenhouses based on shape.
2. Determination of rate of air exchange in an active summer and winter cooling systems.
3. Determination of drying rate of agricultural products inside green house.
4. Study of greenhouse equipments.
5. Determination of engineering properties shape and size, bulk density and porosity of biomaterials.
6. Determination of moisture content of various grains by direct method - oven drying and infra red moisture methods.
7. Determination of moisture content of various grains by indirect method - moisture meter.
8. Performance evaluation of grain winnower
9. Performance evaluation of air screen cleaner
10. Study of fluidized bed dryer
11. Performance evaluation of tray dryer
12. Determination of capacity of a belt conveyor and its performance evaluation
13. Determination of capacity of a bucket conveyor and its performance evaluation
14. Field visit to greenhouse
15. Visit to post harvest laboratories.
16. Visit to Seed processing unit.
17. **FINAL PRACTICAL EXAMINATION**

#### **References:**

1. Singh Brahma and Balraj Singh., 2014. Advances in Protected Cultivation, New India Publishing Company.
2. Greenhouse Management for Horticulture crops -S.Prasad&U.Kumar., 2013. AGROBIOS (INDIA).
3. Greenhouse Management for Horticulture crops -SandhyaSharaf., 2012. Oxford Book Company.
4. Greenhouse for Homeowners and Gardeners - John W. Bartok, Jr., 2000. NRAES
5. Greenhouse Engineering - Robert A. Aldrich and John W. Bartok, Jr., 1994. NRAES



6. Sahay K.M and Singh K .K. Unit operations of agricultural processing. Vikas Publishing house Pvt. Ltd. New Delhi.
7. Chakraverty A. Post-harvest technology of cereals, Pulses and Oil seeds. published by Oxford & IBH publishers. New Delhi.
8. M.N.Dabhi and N.K. Dhamsananiya Agricultural Processing and food engineering (A basic approach) published by Kalyani Publisher. New Delhi.

## **AEN 302 MANAGEMENT OF BENEFICIAL INSECTS (1+1)**

### **Outcomes:**

- In-depth understanding importance of insects beneficial, biology, method of rearing, pests and diseases of honey bee and silkworm.
- Understanding Species of lac insect, morphology, biology, host plant, pollinator, weed killers and scavengers

### **Theory**

**Unit I:** Importance of beneficial Insects, Beekeeping and pollinators, bee biology, commercial methods of rearing, equipment used, seasonal management, bee enemies and disease. Bee pasturage, bee foraging and communication. Insect pests and diseases of honey bee. Role of pollinators in cross pollinated plants.

**Unit II:** Types of silkworm, voltinism and biology of silkworm. Mulberry cultivation, mulberry varieties and methods of harvesting and preservation of leaves. Rearing, mounting and harvesting of cocoons. Pest and diseases of silkworm, management, rearing appliances of mulberry silkworm and methods of disinfection.

**Unit- III:** Species of lac insect, morphology, biology, host plant, lac production – seed lac, button lac, shellac, lac- products. Identification of major parasitoids and predators commonly being used in biological control.

**Unit - IV:** Insect orders bearing predators and parasitoids used in pest control and their mass multiplication techniques. Important species of pollinator, weed killers and scavengers with their importance.

### **Practical**

Honey bee species, castes of bees. Beekeeping appliances and seasonal management, bee enemies and disease. Bee pasturage, bee foraging and communication. Types of silkworm, voltinism and biology of silkworm. Mulberry cultivation, mulberry varieties and methods of harvesting and preservation of leaves. Species of lac insect, host plant identification. Identification of other important pollinators, weed killers and scavengers. Visit to research and training institutions devoted to beekeeping, sericulture, lac culture and natural enemies. Identification and techniques for mass multiplication of natural enemies.

**Theory lecture schedule:**

1. Economic classification of insects 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 variations- Seasonal management of honey bees
4. Different types hives -Bee products- Bee enemies- predators and parasites
5. Bee diseases – bacteria, virus, fungi and protozoan
6. Equipments used in bee keeping
7. 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
8. Pests and diseases of mulberry
9. **Mid semester examination**
10. Types of silkworm - Mulberry silkworm – origin – classification based on voltinism, moultnism, geographical distribution and genetic nature
11. Characters of multivoltine races, bivoltine races, cross breeds and bivoltine hybrids – double hybrids– suitability for rearing in different seasons
12. Morphology and biology of silkworm – sexual dimorphism in immature and adult stages – silkworm genetics – chromosome number – sex limited characters in egg, larva and cocoon for grainage use
13. Methods of chawki and late age silkworm rearing- disinfections- pests and diseases of silkworms
14. Lac insect- biology-strains-Natural enemies of lac insect and lac products
15. Biological control – definition, parasitoids and predators and their role in pest management and mass production.
16. Biological weed control, pollinators, scavengers and soil builders

**Practical schedule:**

1. Identification, morphology and structural adaptations in honey bees
2. Different species of honey bees
3. Bee keeping appliances and seasonal management
4. Rearing of queen, worker and drone cell and colony organization
5. Bee enemies and diseases/ bee products
6. Mulberry nursery bed preparation – methods of planting - Pruning methods – leaf / shoot harvest– preservation of leaves.
7. Pests and diseases of mulberry

8. Different species of silkworms- Chawki and late age silkworm rearing
9. Appliances and disinfection in silkworm rearing
10. Pests and diseases of mulberry silkworm
11. Lac insect-life history, hosts and culturing of lac, natural enemies and lac products
12. Identification and mass culturing of different types of parasitoids
13. Identification and mass culturing of different types of predators
14. Mass production techniques of predators and parasitoids
15. Identification of weeds, and weed killers, pollinators, scavengers and soil builders
16. Visit to research and training institutions for bee keeping, sericulture, lac insect and natural enemies
- 17. Practical examination**

#### References:

1. David, B.V. and V.V. Ramamurthy. 2011. *Elements of Economic Entomology*, Namrutha Publications, Chennai, 386 p. {ISBN: 978-81-921477-0-3}
1. Pedigo, L.P. and M.E.Rice.1996.*Entomology and Pest Management*. Prentice-Hall of India Pvt Ltd, New Delhi. 812p. {ISBN-978-8120338869}
2. Dhaliwal, G.S. and R.Arora. 2001. *Integrated Pest Management – Concepts and approaches*. Kalyani publishers, New Delhi. 427p. {ISBN: 81-7663-904-4}
3. Dandin, S.B., J.Jayaswal and K. Giridhar.2003. *Hand book of Sericulture Technologies*. Central Silk Board, Bangalore, 287 p.
4. Singh.T. and Saratchandra,B.2004.Principles and techniques of silkworm seed production. Discovery publishing house, New Delhi.

#### E – references

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2. <http://www.ncipm.org.in/recent-publications.htm>
3. <http://www.ipmnet.org>
4. [www.silkbase.org](http://www.silkbase.org)
5. [www.papilo.ab.a.u.tokyo.ac.jp](http://www.papilo.ab.a.u.tokyo.ac.jp)

## **AEX 302 ENTREPRENEURSHIP DEVELOPMENT AND BUSINESS COMMUNICATION (1+1)**

### **Outcomes:**

- Understanding the importance of Entrepreneurial process and Entrepreneurship Opportunities.
- Understanding Managerial Functions – I & II and functional area of management.

### **Theory**

#### **Unit I – Entrepreneur and Entrepreneurial process**

Concept and Types of Entrepreneurship - Importance of Entrepreneurship, Characteristics of Entrepreneurs and Entrepreneurial Skills - Entrepreneurial process.

#### **Unit II – Entrepreneurship Opportunities**

Government policy and programs and institutions for entrepreneurship development, Impact of economic reforms on Agribusiness/ Agrienterprises, Entrepreneurial Development Process, Opportunities for agri-entrepreneurship and rural enterprise, SWOT Analysis.

#### **Unit III – Managerial Functions – I**

Planning, managing and setting up of an enterprise – Financing for enterprise : Venture capital, contract farming, Joint venture, PPP. Developing organizational skill (controlling, supervising, problem solving, monitoring & evaluation)

#### **Unit IV – Managerial Functions – II**

Business Leadership Skills (Communication, direction and achievement motivation), problem solving skill.

#### **Unit V – Functional Areas of Management**

Supply Chain Management – Drivers and flows and Total Quality Management – Meaning and Principles, Project Planning Formulation and report preparation

### **Lecture Schedule**

1. Concept of Entrepreneurship and Types of Entrepreneurship
2. Characteristics of Entrepreneurs and Entrepreneurial Skills
3. Entrepreneurial process — Importance of Entrepreneurship
4. Government policy and programs and institutions for entrepreneurship development.
5. Impact of economic reforms on Agribusiness/ Agri-enterprises.
6. Opportunities for agri-entrepreneurship and rural enterprise, SWOT Analysis
7. Entrepreneurial Development Process, Planning, managing and setting up of an enterprise.
8. Financing for enterprise: Venture capital, contract farming, Joint venture, PPP.
9. **Mid Semester**
10. Developing organizational skill (controlling, supervising, problem solving, monitoring & evaluation)
11. Business Leadership Skills (Communication, direction )

12. Motivation, hypothesis behind motivation, entrepreneurial motivation training.
13. Business Leadership Skills - controlling, supervising, problem solving.
14. Managerial skills - Organizing. Communication, direction and Problem solving skill.
15. Supply Chain Management – Importance, Drivers and flows and Total Quality Management – Meaning and Principles
16. Project Planning Formulation and report preparation

### **Practical**

Assessing entrepreneurial traits, practicing business communication, problem solving skills, managerial skills and achievement motivation, exercise in creativity, time audit through planning, monitoring and supervision, identification and selection of business idea, preparation of business plan and proposal writing, visit to entrepreneurship development institute and entrepreneurs.

### **Practical Schedule**

1. Assessment of entrepreneurial traits
2. Practicing business communication
3. Understanding about Problem solving skills through case analysis - I
4. Understanding about Problem solving skills through case analysis - II
5. Discussion and Understanding achievement motivation by case analysis
6. Exercise in creativity
7. Understanding Time audit through planning by case analysis.
8. Visit to entrepreneurship development institutes
9. Visit to firms / discussion with entrepreneurs
10. Exercise on SWOT Analysis of Agribusiness enterprises in India - I
11. Exercise on SWOT Analysis of Agribusiness enterprises in India - II
12. Identification of new business opportunities.
13. Preparation of business plan and proposal writing - I
14. Preparation of business plan and proposal writing - II
15. Presentation and evaluation of the business plan - I
16. Presentation and evaluation of the business plan - II
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.
- 5) Vasant Desai. 2000. Dynamics of Entrepreneurial Development and Management, Himalaya Publishing House, New Delhi.

## E- References

1. [www.ediindia.org/](http://www.ediindia.org/)
2. [iie.nic.in/](http://iie.nic.in/)
3. [msme.gov.in/](http://msme.gov.in/)
4. [niesbudtraining.org](http://niesbudtraining.org)
5. [www.nimsme.org/](http://www.nimsme.org/)
6. [www.nsic.co.in/](http://www.nsic.co.in/)
7. <https://www.nabard.org/>

## **AGR 304      PRACTICAL CROP PRODUCTION – II (*RABI* CROPS)      (0+1)**

### **Outcomes:**

- Each student will be allotted a minimum land area of 100/200 m<sup>2</sup>. He / she will do all field operations in the allotted land from field preparation to harvest and processing.
- Field preparation, seed, treatment, nursery raising, sowing, nutrient, water and weed management and management of insect-pests diseases of crops, harvesting, threshing, drying winnowing, storage and marketing of produce.
- Rice (Transplanted or direct sown)

### **Transplanted rice:**

- Rice ecosystems - Climate and weather - Seasons and varieties of India.
- Preparation of nursery - Application of manures to nursery - seed treatment - Forming nursery beds and sowing seeds - Weed management and plant protection to nursery.
- Preparation of main field - Application of organic manures - Green manuring - Bio-fertilizers - Pulling out seedlings and transplanting - Rajarajan 1000 (SRI) - Application of herbicides - Water management - Nutrient management - Plant protection measures - Mechanization in rice cultivation - Recording growth, yield attributes and yield.
- Harvesting, threshing, drying and cleaning the produce - Working out cost of cultivation and economics.

### **Practical Schedule:**

1. Selection of nursery area, preparation of nursery, application of manures and fertilizer to nursery
2. Study and practice of green manuring and bio-fertilizer application in rice
3. Acquiring skill in seed treatment, seed soaking and incubation, nursery sowing and management
4. Study and practice of main field preparation and puddling operations
5. Practicing of field preparatory operations – sectioning of field bunds and plastering, leveling and basal application of fertilizers

6. Practicing transplanting techniques in lowland rice/ exposure to mechanized transplanting
7. Estimation of plant population and acquiring skill in gap filling and thinning
8. Study of weeds and weed management in rice/ exposure to mechanized weeding
- 9. MID-SEMESTER EXAMINATION**
10. Acquiring skill in nutrient management and practicing top dressing techniques
11. Study of water management practices for lowland rice
12. Observation of insect pests and diseases and their management
13. Recording growth and other related characters of rice
14. Estimation of yield and yield parameters in rice
15. Harvesting, threshing and cleaning of the produce/ exposure to mechanized harvesting & threshing.
- 16. Preparation of balance sheet including cost of cultivation and net returns per student**
- 17. FINAL PRACTICAL EXAMINATION**

#### **References:**

1. Ahlawat, I. P. S. , Om Prakash and G. S. Saini. 1998. Scientific Crop Production in India. Rama Publishing House, Meerut.
2. Chidda Singh. 1997. Modern techniques of raising field crops. Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi.
3. Crop Production Guide. 2012. Directorate of Agriculture, Chennai and Tamil Nadu Agricultural University, Coimbatore.
4. Rajendra Prasad. 2004. Text Book on Field Crop Production, Indian Council of Agrl. Research, New Delhi.
5. K Annadurai and B Chandrasekaran. 2009. A Text Book Of Rice Science. Scientific Publishers.
6. Reddy,S. R. 2012. Agronomy of field crops. Kalyani publishers, New Delhi.
7. ICAR 2015. Hand book of Agriculture. Indian Council of Agriculture, New Delhi.

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1. [www. irri. org](http://www.irri.org)
2. [www. crrl. nic. in](http://www.crrl.nic.in)
3. [www. drrindia. org](http://www.drrindia.org)

### **AGR 305      PRINCIPLES OF ORGANIC FARMING (1+1)**

#### **Outcomes:**

- In-depth understanding impacts of green revolution, organic farming and nutrient management.
- Understanding principles of pest management, organic Certification, marketing, exports opportunities and ITK in organic agriculture

## **Theory**

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

Types of farming – Impacts of green revolution farming – Fate of agro chemicals in ecosystem.

### **Unit II: 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 III: Nutrient 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

### **Unit IV: Pest and disease management in organic farming**

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-inoculants - quality analysis of inputs and products - grading, packaging, post-harvest management – visit to organic farms, market outlets and organic certification centers.

## **Lecture Schedule**

1. Farming – types of farming
2. Impacts of green revolution farming
3. Fate of agro chemicals in ecosystem.
4. Ecology and Principles of ecology. Biodiversity: importance and measure to preserve biodiversity



5. Organic farming: Definition - Scope - Principles and concepts - History of organic farming
6. Organic carbon: status and improvement strategies – conservation tillage.
7. Principles of nutrient management in organic farm - Organic sources and potentials – on farm and off farm sources – organic waste recycling methods
8. Soil and crop management - inter cropping, crop rotation, green manures, cover crops, mulching - bio fertilizers
9. **MID-SEMESTER EXAMINATION**
10. Principles of pest management in organic farm - Bio intensive pest and diseases management - physical, cultural, mechanical and biological methods
11. Non-chemical weed management methods: preventive, physical, cultural, mechanical and biological control measures.
12. Organic certification – NPOP guidelines
13. Certification agencies in India – crop production standards
14. Quality considerations - labeling and accreditation process - marketing and export opportunities.
15. Indigenous Technical Knowledge (ITK) in organic agriculture – Integrated farming system approach
16. Benefits and problems of organic farming – economic evaluation of organic production systems

### **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 ecosystems
15. Organic certification procedures
16. Visit to organic farms, market outlets and organic certification centers
17. **PRACTICAL EXAMINATION**

### **References**

1. Nicholas Lampkin 1994. Organic farming. Farming press London.
2. Arunkumar Sharma 2008. A Hand book of organic farming. Agrobios Publishers.
3. Dahama, A.K.2009. Organic farming for sustainable agriculture, Agrobros publishers.
4. Veeresh, G.K. 2010. Organic farming, Cambridge university press.

5. SP. Palaniappan and K Annadurai. 2008. Organic Farming: Theory and Practice. 2008. Scientific Publishers.
6. Stockdale, E *et al.*, 2000. Agronomic and environmental implications of organic farming systems. *Advances in Agronomy*, 70, 261-327

**FSN 301**

**PRINCIPLES OF FOOD SCIENCE AND NUTRITION**

**2+0**

**Outcomes:**

- In-depth understanding classification and scope of foods, Carbohydrate, Protein and Fat, Vitamin and Mineral Nutrition
- Understanding preservation and processing of Food, requirements of Food Quality and Safety

**Theory**

**Unit I: Principles of Food Science and Nutrition**

Food Science - definition – classification of foods – functional and nutritional classification. Food groups and food pyramid. Methods of cooking - moist, dry and microwave - principles, merits and demerits. Importance and scope of nutrition – relation of nutrition to health.

**Unit -II: Carbohydrate, Protein and Fat**

Carbohydrate – classification, functions, digestion and absorption, sources and Recommended Dietary allowance (RDA). Energy value of foods – determination. Protein – classification, functions digestion and absorption, sources and requirements. Protein quality of foods – supplementary value of protein. Fat - classification functions, digestion and absorption, sources and requirements. Rancidity – types of rancidity and prevention. Deficiency states of protein, carbohydrate and fat nutrition – signs and symptoms.

**Unit III: Vitamin and Mineral Nutrition**

Fat Soluble vitamins – A, D, E and K- functions, sources, requirements and deficiency. Water soluble vitamins – thiamine , riboflavin , niacin, pyridoxine, folic acid, cyanacobalamin, biotin, pantothenic acid ascorbic acid – functions, sources, deficiency and requirements. Minerals - calcium, iron, phosphorus, iodine, magnesium, zinc, sodium, potassium, fluorine and chlorine – functions, sources, deficiency and requirements. Importance of water – maintenance of electrolyte balance. Dietary fibre - importance, health benefits, sources and requirements.

**Unit IV: Food Preservation and Processing**

Introduction – preservation by sugar - processing of jam, squash, jelly, marmalade and beverages. Preservation by using salt, chemicals, dehydration technology, canning technology, preservation by low temperature and irradiation techniques. Processing of puffed, flaked and extruded products. Quality control of raw and processed products.

## Unit V: Food Quality and Safety

Food packaging materials – requirements – methods – nutrition labeling. Food adulterants and their detection methods. Food laws and regulations and quality control standards - FSSAI, ISO, EU standards, FDA, HACCP and Codex Alimentarius Commission.

### Lecture Schedule

1. Food Science – definition, scope and classification, food pyramid
2. Methods, merits and demerits of moist heat, dry heat and microwave cooking of foods.
3. Importance and scope of nutrition and the relation of nutrition to health.
4. Concepts of food science (density, phase change, pH, osmosis, surface tension, colloidal system *etc.*)
5. Carbohydrate – classification, functions, digestion and absorption, deficiency symptoms, sources and requirements.
6. Protein – classification, functions, digestion and absorption, deficiency symptoms, sources and requirements.
7. Protein quality – supplementary value of protein.
8. Fat - classification, functions, digestion and absorption, deficiency symptoms, sources and requirements.
9. Rancidity – types and prevention methods.
10. Determination of energy value of foods.
11. Fat soluble vitamins – A, D, E and K – functions, deficiency symptoms, sources and requirements.
12. Water soluble vitamins - thiamine, riboflavin, niacin, pyridoxine, folic acid, cyanacobalamin, biotin, pantothenic acid, ascorbic acid – functions, deficiency symptoms, sources and requirements.
13. Minerals – calcium, iron, phosphorus, potassium – functions, sources, requirements and deficiency diseases.
14. Minerals –iodine, magnesium, zinc, sodium, fluorine and chlorine – functions, sources, requirements and deficiency diseases.
15. Importance of water and maintenance of electrolyte balance.
16. Health benefits of fibre, requirements and sources
17. **MIDSEMESTER EXAMINATION**
18. Energy metabolism
19. RDA and factors affecting RDA, RDA for various age groups.
20. Assessment of Nutritional status – Anthropometric, clinical, biophysical, functional, biochemical dietary assessments and vital health statistics
21. Balanced and modified diets, menu planning
22. New trends in food science and nutrition
23. Principles and methods of food processing and preservation (use of heat and low temperature)
24. Methods of food processing and preservation (use of chemicals, drying and radiation)
25. Types of dryers

26. Preservation by using sugar (jam, jelly, squash and marmalade), preservation by using salt (brining and pickling) and use of preservatives in food preservation.
27. Production of fermented food
28. Food microbiology (Bacteria, yeast, moulds spoilage of fresh and processed food)
29. Browning reaction of fruits and vegetables.
30. Food packaging – importance, types of packaging materials and nutrition labeling.
31. Common food adulterants and their detection.
32. Food laws and regulations and quality control standards - FSSAI, ISO, EU standards, FDA, HACCP and Codex Alimentarius Commission.

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2. Srivastava, R.P., and Sanjeevkumar. S. 2013. Fruit and Vegetable preservation. International Book Distributing Co. Lucknow.
3. Srilakshmi .B. 2015. Nutrition Science. New Age International Pvt. Ltd. New Delhi.
4. The Indian Journal of Nutrition and Dietetics
5. Journal of Food Science and Technology
6. Critical Reviews of Food Science and Nutrition
7. [www.cellinteractive.com](http://www.cellinteractive.com)
8. [www.nutrition.org.uk](http://www.nutrition.org.uk)
9. [www.fnict.nal.usda.gov](http://www.fnict.nal.usda.gov)
10. [www.myfooddiary.com](http://www.myfooddiary.com)

## GBP 301 CROP IMPROVEMENT (2+1)

### Outcomes:

- In-depth understanding the origin, distribution, conservation of species in cereals, millets, pulses, oilseeds, fibers and vegetables.
- Understanding the importance of Intellectual Property, Maintenance breeding and IPR Issues

## THEORY

### Unit I: Breeding Cereals

Centers of origin, distribution of species, wild relatives in different cereals, pulses, oilseeds; Plant genetic resources, its utilization and conservation; Floral biology; study of genetics of qualitative and quantitative characters; Major breeding objectives and procedures including conventional and modern innovative approaches for development of hybrids and varieties for yield, adaptability, stability, abiotic and biotic stress tolerance and quality (physical, chemical, nutritional); Ideotype concept and climate resilient crop varieties for future in the following crops.

Cereals and Millets: Rice, Wheat, Maize, Sorghum, Pearl millet and Finger millet.

## **Unit II: Breeding Pulses and Oilseeds**

Centers of origin, distribution of species, wild relatives in different cereals, pulses, oilseeds; Plant genetic resources, its utilization and conservation; Floral biology; study of genetics of qualitative and quantitative characters; Major breeding objectives and procedures including conventional and modern innovative approaches for development of hybrids and varieties for yield, adaptability, stability, abiotic and biotic stress tolerance and quality (physical, chemical, nutritional); Ideotype concept and climate resilient crop varieties for future in the following crops.

**Pulses:** Red gram, Bengal gram, Green gram, Black gram, Cowpea and Soybean. Oilseeds: Groundnut, Sunflower, Gingelly, Castor, Rape and Mustard.

## **Unit III: Breeding Cash crops and Fodder crops**

Centers of origin, distribution of species, wild relatives in different cereals, pulses, oilseeds; Plant genetic resources, its utilization and conservation; Floral biology; study of genetics of qualitative and quantitative characters; Major breeding objectives and procedures including conventional and modern innovative approaches for development of hybrids and varieties for yield, adaptability, stability, abiotic and biotic stress tolerance and quality (physical, chemical, nutritional); Ideotype concept and climate resilient crop varieties for future in the following crops.

**Fibres:** Cotton, Mesta and Jute; Sugars and starches: Sugarcane and Potato; Fumitories: Tobacco and Areca nut; Fodder: Guinea grass, Napier grass, Cumbu – Napier hybrids, Lucerne and *Stylosanthes*.

## **Unit IV: Breeding Horticultural crops**

Centers of origin, distribution of species, wild relatives in different cereals, pulses, oilseeds; Plant genetic resources, its utilization and conservation; Floral biology; study of genetics of qualitative and quantitative characters; Major breeding objectives and procedures including conventional and modern innovative approaches for development of hybrids and varieties for yield, adaptability, stability, abiotic and biotic stress tolerance and quality (physical, chemical, nutritional); Ideotype concept and climate resilient crop varieties for future in the following crops.

**Vegetable crops:** Bhendi, Tomato, Brinjal, Chilli, Cabbage, Cauliflower, Radish, Amaranthus, Drumstick, Ridge gourd, Bottle gourd, Bitter gourd and Cucumber. Spices and Condiments: Onion, Garlic, Turmeric and Ginger. Fruit crops: Mango, Papaya, Banana and Guava. Flower crops: Rose and Jasmine

## **Unit V: Maintenance breeding and IPR Issues**

All India Coordinated Crop Improvement Projects. Procedure for release of new varieties; stages in seed multiplication; steps in nucleus and breeder seed production. Varietal rundown and renovation. Participatory plant breeding. Intellectual Property rights issues. Protection of plant varieties under UPOV and PPV & FR Act of India. Plant breeder's rights, Registration of plant varieties under PPV & FR Act 2001. Breeders right, researcher rights and farmers rights.

## **PRACTICAL**

Observation on floral biology – anthesis and pollination – selfing – crossing techniques – observation on cultivated germplasm, wild species – Experimental design – handling segregating generations- Yield trials in following crops- Rice, Maize and Sorghum, Pearl millet and Finger millet, Red gram, Bengal gram, Green gram, Black gram, Cowpea and Soybean, Groundnut and Sunflower, Sesame and Castor, Cotton, Jute, Sugarcane, Potato, Guinea grass, Napier grass, Cumbu–Napier hybrids, Lucerne, *Stylosanthes*, Bhendi, Brinjal, Tomato, Chilli, Cabbage, Cauliflower, Radish, Amaranthus, Ridge gourd, snake gourd, Bitter gourd, Cucumber, Radish, Onion, Garlic, Turmeric, Ginger, Mango, Papaya, Banana, Guava, Rose and Jasmine. Nucleus and Breeder seed production in field crops. Visit to AICRIP and hybrid Seed production plots of different crops.

## **Theory Lecture schedule**

Centers of origin, distribution of species, wild relatives in different cereals, pulses, oilseeds; Plant genetic resources, its utilization and conservation; Floral biology; study of genetics of qualitative and quantitative characters; Major breeding objectives and procedures including conventional and modern innovative approaches for development of hybrids and varieties for yield, adaptability, stability, abiotic and biotic stress tolerance and quality (physical, chemical, nutritional); Ideotype- concept and climate resilient crop varieties for future in the following crops:

1. Cereals: Rice.
2. Cereals: Rice.
3. Cereals: Wheat
4. Cereals : Maize
5. Cereals: Sorghum
6. Cereals: Pearl millet and Finger millet,
7. Pulses: Red gram and Bengal gram
8. Pulses: Green gram and Black gram
9. Pulses: Soybean and Cowpea
10. Oilseeds: Groundnut and Gingelly
11. Oilseeds: Rapeseed and Mustard
12. Oilseeds: Castor and Sunflower
13. Fibres: Cotton and Jute
14. Sugars and starches: Sugarcane and Potato
15. Forrage Grasses: Guinea grass, Napier grass, Cumbu-Napier hybrids
16. Forage legumes: Lucerne and *Stylosanthes*
17. **Mid Semester Examination**
18. Fumitories and Narcotics: Tobacco and Areca nut
19. Vegetable crops: Bhendi and Brinjal,
20. Vegetable crops: Tomato and Chilli
21. Vegetable crops: Cabbage and Cauliflower
22. Vegetable crops: Radish and Amaranthus and Drumstick
23. Vegetable crops: Ridge gourd and Bottle gourd
24. Vegetable crops: Bitter gourd and Cucumber

25. Spices and Condiments: Onion and Garlic
26. Spices and Condiments: Turmeric and Ginger
27. Fruit crops: Mango and Papaya
28. Fruit crops: Banana and Guava
29. Flower crops: Rose and Jasmine.
30. All India Coordinated Crop Improvement Projects. Procedure for release of new variety.
31. Stages of seed production. Nucleus and Breeder seed production of field crops. Varietal rundown and renovation.
32. Intellectual property and IPR Issues. Protection of plant varieties under UPOV and PPV & FR Act of India, Plant breeder's rights. Registration of plant varieties under PPV & FR Act, 2001. Breeders, researcher and farmers rights.

### **Practical schedule**

Observation on floral biology – anthesis and pollination – selfing – crossing techniques – observation on cultivated germplasm, wild species – Experimental design – handling segregating generations- Yield trials in following crops.

1. Rice
2. Wheat and Maize
3. Sorghum, Pearl millet and Finger millet
4. Red gram, Bengal gram, Cowpea and Soybean
5. Green gram, Black gram and Groundnut
6. Sesamum, Sunflower, Mustard and Castor
7. Cotton and Jute
8. Sugarcane and Potato
9. Guinea grass, Cumbu – Napier hybrids, Lucerne and *Stylosanthes*
10. Bhendi, Brinjal, Tomato and Chilli
11. Cabbage, Cauliflower, Radish, Amaranthus and Drumstick
12. Ridge gourd, Bottle gourd, Bitter gourd and Cucumber
13. Onion, Garlic, Turmeric and Ginger
14. Mango, Papaya, Banana and Guava
15. Rose and Jasmine
16. Visit to AICRP and Hybrid seed production plots of different field crops

### **17. Final Practical Examination**

### **References**

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2. Phundan Singh. 2006. Essential of Plant Breeding. Kalyani Publishers, Ludhiana. 54
3. Poehlman, J.M. and Borthakur, D. 1995. Breeding of Asian Field Crops. Oxford & IBH Publishing Co. Pvt. Ltd. New Delhi.
4. Sharma, J.R. 1994. Principles and Practice of Plant Breeding. Tata McGraw-Hill Publishing Co. Ltd., New Delhi.
5. Kalloo, G.1994. Vegetable Breeding. Panima Educational Book Agency, New Delhi.
6. Kumar, N. 2006. Breeding of Horticultural Crops - Principles and Practices. New India Publishing Agency, New Delhi.

7. George Acquaah..2012. Principles of Plant Genetics and Breeding. Blackwell Publishing Ltd., USA.
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**HOR 312**

**POST-HARVEST MANAGEMENT AND VALUE ADDITION OF  
FRUITS AND VEGETABLES**

**1+1**

**Outcomes:**

- In-depth understanding the principles and importance of postharvest technology and physiology of ripening in fruits and vegetables
- Understanding preservation, dehydration and canning techniques in fruits and vegetables

**Theory**

**UNIT I - Principles and importance of postharvest technology**

Importance of fruits and vegetables, extent and possible causes of post harvest losses; Pre-harvest factors affecting postharvest quality, maturity, ripening and changes occurring during ripening.

**UNIT II - Post harvest handling and physiology of ripening**

Respiration and factors affecting respiration rate; Role of ethylene; Post harvest disease and disorders; Heat, chilling and freezing injury; Harvesting and field handling; Storage (ZECC, cold storage, CA, MA, and hypobaric).



### **UNIT III - Value addition and preservation**

Value addition concept; Principles and methods of preservation; Intermediate moisture food- Jam, jelly, marmalade, preserve, candy – Concepts and Standards; Fermented and nonfermented beverages.

### **UNIT IV– Value added products and dehydration techniques**

Tomato products- Concepts and Standards; Drying/ Dehydration of fruits and vegetables – Concept and methods, osmotic drying.

### **UNIT V – Canning technology**

Canning – Concepts and Standards, Packaging of products.

### **PRACTICAL**

Applications of different types of packaging containers for shelf life extension, Effect of temperature on shelf life and quality of produce, Demonstration of chilling and freezing injury in vegetables and fruits, Extraction and preservation of pulps and juices, Preparation of jam, Preparation of Jelly, Preparation of RTS, Preparation of Nectar, Preparation of Squash, Osmotically dried products, Fruit bar and Candy and Tomato products, Canned products, Quality evaluation of products — physico-chemical and sensory, Visit to processing unit/ industry

### **Lecture schedule**

1. Scope and Importance of post-harvest technology of fruits and vegetables - Extent and possible causes of post-harvest losses - Causes of post-harvest losses.
2. Pre-harvest factors affecting postharvest quality, maturity, ripening and shelf life of fruits and vegetables – Environmental factors (Temperature, Light, Rainfall, Wind, Relative humidity) – Cultural factors – (Rootstock, Variety, Mineral nutrients, growth regulators, Irrigation, pruning, thinning, girdling) – Maturity – Pest and diseases.
3. Changes occurring during ripening – Ripening definition - Climacteric and non-climacteric fruits – Metabolic changes - Maturation of seeds – Colour – Texture - Changes in carbohydrates- Changes in aromatic volatiles - Changes in organic acids – Fruit abscission – Changes in respiration rate – Development of surface waxes – Changes in tissue permeability.
4. Causes for deterioration of harvested fruits and Vegetables -Respiration and factors affecting respiration rate – Transpiration and factors affecting transpiration - Ethylene – Mechanical damage – Pest and Diseases.
5. Post harvest diseases and disorders - Heat, chilling and freezing injury.
6. Harvesting and field handling – Methods of harvesting – Post harvest handling – Pre-cooling - Sorting and grading – Disinfestation – Post harvest treatments (Waxing, Wrapping, de-greening, ripening).
7. Storage – Methods of storage – Traditional storages (In-situ, pit storage, high altitude, clamp storage, wind breaks, cellars, barns, Night ventilation, Evaporative cool storage ZECC) - Improved storage methods (Refrigerated storage, modified atmospheric storage, controlled atmospheric storage, hypobaric storage).

8. Packaging of products - Definition – Properties of good packaging material – Different packaging materials for fresh fruits and vegetables for export – Cushioning materials – Purpose – Characteristics of cushioning material.
9. **MID SEMESTER EXAMINATION**
10. Value addition – Concept – Scope and importance of fruit preservation in India – Status of fruit preservation in India. Principles and methods of preservation – Principles of preservation – Preservation methods – High temperature, low temperature, drying, filtration, chemicals, food additives, fermentation, carbonation, antibiotics, irradiation etc.
11. Intermediate moisture foods - Jam, jelly, marmalade – Problems in Jam making important considerations and problems in Jelly making- Problems in marmalade making.
12. Preserve, candy – Concepts and Standards – Flow chart for manufacturing of preserve and candy – Problems in preservation of preserve and candied fruits – Glazed fruits/vegetables.
13. Fruit beverages –Fermented (Juices, Ready to serve, Nectar, cordial, Squash, crush, Syrup, Fruit Juice concentrate, Fruit Juice, Powder, Carbonated beverages) and non-fermented beverages (Wine, Champagne, Port, Sherry, Tokay, Muscat, Perry, Nira, Feni, Cider) – Preparation and preservation of unfermented fruit beverages.
14. Tomato processing - Concepts and Standards – Tomato juice – Tomato puree and paste – Tomato sauce/ketchup- Tomato chutney/pickle –Tomato cocktail – Tomato soup – Canned tomatoes.
15. Drying/dehydration of fruits and vegetables – Factors affect the rate of drying – Advantages of dehydration over sun drying – Process of drying/dehydration of fruits and vegetables – Spoilage of dried fruits and vegetables - Freezing – Methods of freezing.
16. Canning of fruits and vegetables – Selection of fruits and vegetable - Causes of spoilage of canned foods – Testing for defects - Containers for packing of canned products – Tin containers, glass containers.

### **Practical Schedule**

1. Applications of different types of packaging containers for shelf life extension.
2. Effect of temperature on shelf life and quality of produce.
3. Demonstration of chilling and freezing injury in vegetables and fruits.
4. Extraction and preservation of pulps and juices.
5. Preparation of jam.
6. Preparation of jelly.
7. Preparation of RTS.
8. Preparation of nectar.
9. Preparation of squash.
10. Preparation of osmotically dried products.
11. Preparation of fruit bar and candy.
12. Preparation of tomato sauce.
13. Preparation of tomato ketchup.

14. Preparation of canned products.
15. Quality evaluation of products - (physic-chemical and sensory).
16. Visit to processing unit/ industry.
17. **PRACTICAL EXAMINATION**

### **References**

1. Rathore, N.S., Mathur, G.K., Chasta, S.S. 2012. Post-harvest Management and Processing of Fruits and Vegetables. ICAR, New Delhi.
2. Srivastava, R.P. and Sanjeev Kumar. 2002. Fruit and Vegetable Preservation: Principles and Practices. International Book Distribution Company, Lucknow.
3. Giridharilal, G.S., Siddappa and Tondon, G.L. 2007. Preservation of Fruits and Vegetables. ICAR, New Delhi.
4. Mitra, S.K. 2005. Post Harvest Physiology and Storage of Tropical and Subtropical Fruits. CABI Publishers, Kolkatta.

## **PAT 302      Diseases of Field and Horticultural crops and their management-II    (2+1)**

### **Outcomes:**

- In-depth understanding the Etiology, symptoms, mode of spread, survival, epidemiology & integrated management of important diseases of Cereals, Cash and Vegetable crops.
- Understanding the Etiology, symptoms, mode of spread, survival, epidemiology & integrated management of important diseases of Plantation crops & mushroom

### **Theory**

Etiology, symptoms, mode of spread, survival, epidemiology and integrated management of important diseases of the following crops

#### **Unit I: Diseases of cereals, pulses and oil seed crops**

Cereals: Wheat - Pulses: Chick pea and lentil - Oil seeds - Sunflower and mustard

#### **Unit II: Diseases of cash crops and fruit crops**

Cash crops: Cotton and sugarcane - Fruit crops: Mango, citrus, grapevine, apple, peach, plum and pear

#### **Unit III: Diseases of vegetable and spice crops**

Vegetable crops: Cucurbits, peas, potato, cassava, colacasia and yam - Post harvest diseases of fruits and vegetables - Spice crops: Chillies, ginger, turmeric, onion, garlic, coriander, cardamom

#### **Unit IV: Diseases of plantation and flower crops**

Plantation crops: Black pepper and betelvine - Flower crops: Rose, jasmine, marigold, crossandra, chrysanthemum, tube rose, carnation, lillium and orchids

#### **Unit V: Mushroom cultivation**

Importance of mushroom - Cultivation of oyster mushroom, milky mushroom, paddy straw mushroom and button mushroom – Constraints in mushroom cultivation - Post harvest technology

#### **PRACTICAL**

Study of symptoms and host parasite relationship of the important diseases of wheat, chick pea, lentil, sunflower, mustard, cotton, sugarcane, mango, citrus, grapevine, apple, peach, plum, pear, cucurbits, potato, peas, cassava, colacasia, yam, chillies, turmeric, ginger, onion, garlic, coriander, cardamom, black pepper, betelvine, rose, jasmine, marigold, crossandra, chrysanthemum, tube rose, carnation, lillium, orchids and cultivation of button mushroom, oyster mushroom, milky mushroom and paddy straw mushroom.

#### **THEORY**

Etiology, symptoms, mode of spread, survival, epidemiology and integrated management of

1. Diseases of wheat
2. Diseases of chickpea and lentil
3. Diseases of sunflower and mustard
4. Diseases of cotton
5. Diseases of sugarcane
6. Diseases of mango
7. Diseases of citrus
8. Diseases of grapevine
9. Diseases of apple
10. Diseases of peach, plum and pear
11. Diseases of cucurbits
12. Diseases of potato
13. Diseases of peas
14. Diseases of cassava, colacasia and yam
15. Post-harvest diseases of fruits and vegetables
16. Diseases of chillies
17. **Mid semester examination**
18. Diseases of turmeric and ginger
19. Diseases of onion and garlic
20. Diseases of cardamom and coriander

21. Diseases of black pepper and betel vine
22. Diseases of rose and jasmine
23. Diseases of marigold, crossandra and chrysanthemum
24. Diseases of tube rose and carnation
25. Diseases of lillium and orchids
26. Mushroom - Medicinal and nutritional values of mushroom
27. Mushroom spawn preparation
28. Cultivation of oyster mushroom and milky mushroom
29. Cultivation of paddy straw mushroom
30. Substrates for button mushroom - Compost preparation
31. Cultivation of button mushroom
32. Constraints in mushroom cultivation and post-harvest technology

## **PRACTICAL**

### **Study of symptoms and host-parasite relationship of:**

1. Diseases of wheat
2. Diseases of chick pea, lentil, sunflower and mustard
3. Diseases of cotton and sugarcane
4. Diseases of mango
5. Diseases of citrus and grapevine
6. Diseases of apple, peach, plum and pear
7. Diseases of cucurbits
8. Diseases of potato and peas
9. Diseases of cassava, colacasia and yam
10. Field visit/ exposure visit to fruits , vegetables and plantation crops / mushroom unit
11. Diseases of chillies, turmeric and ginger
12. Diseases of onion and garlic
13. Diseases of coriander, cardamom, black pepper and betelvine
14. Diseases of flower crops
15. Cultivation of oyster, milky and paddy straw mushroom
16. Cultivation of button mushroom
17. Final practical examination

## **Reference Books**

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2. Rangasawmi ,G and Mahadevan, A. 1998. Diseases of crop Plants in India, Prentice Hall of India Pvt. Ltd., New Delhi

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## SEMESTER VI

Sl.No.	Course No.	Course Title	Cr.Hr.
1.	AEC 302	Agricultural Finance and Cooperation	2+1
2.	AEG 302	Protected Cultivation and Secondary Agriculture	1+1
3.	AEN 302	Management of Beneficial Insects	1+1
4.	AEX 302	Entrepreneurship Development and Business Management	1+1
5.	AGR 304	Practical Crop Production –II ( <i>Rabi</i> crops)	0+1
6.	AGR 305	Principles of Organic Farming	1+1
7.	FSN 301	Principles of Food Science and Nutrition	2+0
8.	GPB 301	Crop Improvement	2+1
9.	HOR 312	Post-harvest Management and Value Addition of Fruits and Vegetables	1+1
10	PAT 302	Diseases of Field and Horticultural Crops and their Management-II	2+1
11.	---	Elective Course-3	2+1
TOTAL			15+10=25

## **AEC 302 Agricultural Finance and Co-operation (2+1)**

### **Outcomes:**

- In-depth understanding about nature and scope of Agricultural Finance, Financial Institutions and Farm Financial Analysis.
- Understanding Co-operation, Banking and Insurance.

### **Theory**

#### **Unit 1: Agricultural Finance – Nature and Scope:**

Agricultural Finance- meaning, scope and significance, credit needs and its role in Indian agriculture. Agricultural credit: meaning, definition, need, classification. Sources of credit - advantages and disadvantages - Rural indebtedness- History and Development of rural credit in India.

#### **Unit 2: Financial Institutions:**

Sources of agricultural finance: institutional and non-institutional sources and their roles, commercial banks - social control and nationalization of commercial banks – AD branches – Area approach – Priority sector lending. Micro financing including KCC, Micro finance – SHG Models, Lead Bank Scheme, RRBs, Scale of finance and unit cost. Cost of credit. An introduction to higher financing institutions – RBI, NABARD, ADB, IMF, World Bank, Insurance and Credit Guarantee Corporation of India. Recent development in agricultural credit: Rural credit policies of Government – Subsidized farm credit - Differential Interest Rate (DIR) Scheme – Loan relief measures

#### **Unit 3: Farm Financial Analysis:**

Credit analysis: 3 R's, 7 P's and 5 C's of credit. Preparation of bankable projects / Farm credit proposals – Feasibility; Appraisal - Time value of money: Compounding and Discounting - Undiscounted and Discounted measures. Preparation and analysis of financial statements Balance Sheet, Income Statement and Cash Flow Statement. Basic guidelines for preparation of project reports - Bank norms – SWOT analysis.

#### **Unit 4: Co-operation:**

Agricultural Cooperation in India—Meaning, brief history of cooperative development in India - Pre and Post - Independence periods and Co-operation in different plan periods, objectives, principles of cooperation, significance of cooperatives in Indian agriculture. Co-operative credit structure: short term and long term. Agricultural Cooperation - credit, marketing, consumer and multi-purpose cooperatives, farmers' service cooperative societies, processing cooperatives, farming cooperatives, cooperative warehousing; role of ICA, NCUI, NCD, NAFED. Strength and weakness of co-operative credit system, Policies for revitalizing co-operative credit.

#### **Unit 5: Banking and Insurance:**

Negotiable Instruments: Meaning, Importance and Types - Central bank: RBI – functions - Credit control – Objectives and Methods: CRR, SLR and Repo rate - Credit rationing - Dear



money and cheap money. monetary policies. Credit gap: Factors influencing credit gap. Non - Banking Financial Institutions (NBFI). NPA – Causes, consequences and mitigation. Crop Insurance: Schemes, Coverage, Advantages and Limitations in Implementation. Weather based crop insurance, features, determinants of compensation. Livestock Insurance Schemes - Agricultural Insurance Company of India Ltd (AIC): Objectives and functions.

## **Practical**

Determination of most profitable level of capital use. Optimum allocation of limited amount of capital among different enterprise. Analysis of progress and performance of cooperatives using published data. Analysis of progress and performance of commercial banks and RRBs using published data. Visit to a commercial bank, cooperative bank / cooperative society to acquire first- hand knowledge of their management, schemes and procedures. Visit to District Central Co-operative Bank (DCCB) to study its role, functions and procedures for availing loan – Fixation of Scale of Finance. Estimation of credit requirement of farm business – A case study. Preparation and analysis of Balance Sheet, and Cash Flow Statement – A case study. Exercise on Financial Ratio Analysis. Appraisal of farm credit proposals – A case study. Preparation and analysis of income statement – A case study. Preparation of Bankable projects / Farm Credit Proposals and appraisal - Undiscounted methods and Discounted methods. Techno-economic parameters for preparation of projects for various agricultural products and its value added products. Seminar on selected topics. Analysis of Different Crop Insurance Products / Visit to crop insurance implementing agency.

## **Theory Schedule**

1. Agricultural Finance - meaning, scope and significance, credit needs and its role in Indian agriculture.
2. Agricultural credit: meaning, definition, need and classification.
3. Sources of credit - advantages and disadvantages.
4. Rural indebtedness - History and Development of rural credit in India.
5. Sources of agricultural finance: institutional and non-institutional sources - their roles.
6. Commercial banks - social control and nationalization of commercial banks.
7. Micro financing including KCC, Micro finance – SHG Models, Lead bank scheme.
8. RRBs, Scale of finance and unit cost. Cost of credit.
9. An introduction to higher financing institutions—RBI, NABARD, ADB, IMF and World Bank.
10. Role of Insurance and Credit Guarantee Corporation of India.
11. Recent developments in agricultural credit.
12. Rural credit policies of Government: Subsidized farm credit- Differential Interest Rate (DIR) Scheme— Loan relief measures
13. Credit analysis: 3 R's, 7 P's and 3C's of credit.
14. Preparation of bankable projects / Farm credit proposals – Feasibility.
15. Appraisal: Time value of money: Compounding and Discounting - Undiscounted and Discounted measures.
16. Preparation and analysis of financial statements – Balance Sheet, Income Statement and Cash Flow Statement.

### **17. Mid Semester Examination**

18. Basic guidelines for preparation of project reports- Bank norms – SWOT analysis.
19. Agricultural Cooperation in India – Meaning, brief history of cooperative development in India.
20. Pre and Post - Independence periods and Co-operation in different plan periods, objectives, principles of cooperation, significance of cooperatives in Indian agriculture.
21. Co-operating credit structure: short term and long term. Agricultural Cooperation - credit, marketing, consumer and multi-purpose cooperatives, farmers' service cooperative societies, processing cooperatives, farming cooperatives, cooperative warehousing;
22. Role of ICA, NCUI, NCDC and NAFED.
23. Strength and weakness of co-operative credit system, Policies for revitalizing co-operative credit.
24. Negotiable Instruments: Meaning, Importance and Types.
25. Central bank: RBI – functions, Credit control – Objectives and Methods: CRR, SLR and Repo rate.
26. Credit rationing - Dear money and cheap money.
27. Financial Inclusion and Exclusion: credit widening and credit deepening monetary policies.
28. Credit gap: Factors influencing credit gap.
29. Non - Banking Financial Institutions (NBFI). NPA – Causes, consequences and mitigation.
30. Crop Insurance and Livestock Insurance Schemes: Coverage, Advantages and Limitations in Implementation.
31. Weather based crop insurance, features, determinants of compensation.
32. Agricultural Insurance Company of India Ltd (AIC): Objectives and functions.

### **Practical Schedule**

1. Determination of most profitable level of capital use.
2. Optimum allocation of limited amount of capital among different enterprises.
3. Analysis of progress and performance of cooperatives using published data.
4. Analysis of progress and performance of commercial banks and RRBs using published data.
5. Visit to a commercial bank, cooperative bank / cooperative society to acquire first - hand knowledge of their management, schemes and procedures.
6. Visit to District Central Co-operative Bank (DCCB) to study its role, functions and procedures for availing loan – Fixation of Scale of Finance.
7. Guest lecture on Role and functions of Commercial Bank and Lead Bank / NABARD and its Role and Functions.
8. Estimation of credit requirement of farm business – A case study.
9. Preparation and analysis of Balance Sheet and Cash Flow Statement – A case study.
10. Exercise on Financial Ratio Analysis. Appraisal of farm credit proposals – A case study.
11. Preparation and analysis of income statement – A case study.
12. Preparation of Bankable projects / Farm Credit Proposals and appraisal.
13. Undiscounted methods and Discounted methods.
14. Techno-economic parameters for preparation of projects for various agricultural products and its value added products.
15. Analysis of Different Crop Insurance Products / Visit to crop insurance implementing agency.

16. Seminar on selected topics.

17. **Practical Examination.**

### **References**

1. Muniraj, R. 1987. Farm Finance for Development. Oxford & IBH. New Delhi.
2. Subba Reddy, S and P. Raghu Ram. 2011. Agricultural Finance and Management. Oxford & IBH. New Delhi.
3. Lee, W.F., M.D. Boehlje, A.G. Nelson and W.G. Murray. 1998. Agricultural Finance. Kalyani Publishers. New Delhi.
4. Mammoria, C.B. and R.D. Saxena. 1973. Cooperation in India. KitabMahal. Allahabad.
- Patnaik, V.E. and A.K. Roy. 1988. Cooperation and Cooperative Management. Kalyani Publishers. Ludhiana.

### **E-References:**

1. [www.pajancoa.ac.in](http://www.pajancoa.ac.in)
2. [www.tawn.tnau.ac.in](http://www.tawn.tnau.ac.in)
3. [www.usbr.gov/pn/agri.met](http://www.usbr.gov/pn/agri.met)

## **AEG 302 PROTECTED CULTIVATION AND SECONDARY AGRICULTURE (1+1)**

### **Outcomes:**

- In-depth understanding about protected cultivation, application and design of green houses.
- Understanding Engineering properties of food materials, Drying, dehydration and material handling.

### **Theory:**

#### **Unit I: Protected cultivation and design of green houses**

Protected cultivation - need, advantages and limitations - present status. Green house technology - introduction - types of greenhouses - plant response to greenhouse environment. Planning and design of greenhouses - design criteria of green house for cooling and heating purposes - green house equipments - materials for construction of traditional and low cost green houses- irrigation systems used in greenhouses.

#### **UNIT II: Applications of greenhouses**

Typical applications - passive solar greenhouse - hot air greenhouse heating systems - greenhouse drying - cost estimation and economic analysis.

#### **UNIT III: Engineering properties of food materials**

Important engineering properties: physical, thermal, aero and hydro dynamic mechanical, frictional, rheological and optical properties of cereals, pulses and oil seeds and their application in PHT equipment design and operation.

#### **UNIT IV: Drying and dehydration**

Drying and dehydration, moisture determination- direct method and indirect method of moisture determination. EMC - importance of EMC - drying theory - drying rate periods- constant rate period- falling rate period - CMC. Drying methods- contact type dryers- convective type dryer- radiation dryer. Commercial grain dryer - deep bed dryer, flat bed dryer, tray dryer, fluidized bed dryer, recirculatory dryer, LSU dryer and solar dryer - types of solar dryer.

#### **UNIT V: Material handling**

Material handling - material handling equipments- selection of material handling equipments. Belt conveyor- bucket elevator - screw conveyor - pneumatic conveyor - their working principle and selection - capacity - horse power - advantages and limitations.

##### **Practical:**

Study of different type of greenhouses based on shape. Determine the rate of air exchange in an active summer winter cooling system. Determination of drying rate of agricultural products inside green house. Study of greenhouse equipments. Visit to various Post Harvest Laboratories. Determination of moisture content of various grains by oven drying & infrared moisture methods. Determination of engineering properties (shape and size, bulk density and porosity of biomaterials). Determination of Moisture content of various grains by moisture meter. Field visit to seed processing plant.

##### **Lecture schedule:**

1. Introduction to protected cultivation - need, advantages and limitations and present status - green house technology - types of greenhouses
2. Plant response to greenhouse environment - sunlight, temperature, relative humidity, carbon dioxide enrichment - soil / media
3. Planning and design of greenhouses - design criteria of green house for cooling and heating purposes.
4. Green house equipments - materials for construction of traditional and low cost green houses - irrigation systems used in greenhouses.
5. Typical applications of greenhouses - passive solar greenhouse, hot air greenhouse heating system
6. Green house drying- cost estimation and economic analysis.
7. Important Engineering properties of cereals, pulses and oilseeds and their application in PHT equipment design and operation.
8. Physical properties – size - shape - sphericity - density - specific gravity. Mechanical properties – aero and hydrodynamic properties - terminal velocity - drag coefficient - application.
9. **MID SEMESTER EXAMINATION.**
10. Thermal properties- specific heat - thermal conductivity- thermal diffusivity - Frictional properties - angle of repose - angle of internal friction - optical and rheological properties- application
11. Drying and dehydration - moisture measurement, direct method and indirect methods of moisture measurements.

12. EMC - importance of EMC - drying theory- drying rate periods - constant rate period, falling rate period, CMC.
13. Drying methods - contact type dryers - convective type dryer- radiation dryer - Commercial grain dryers - thin layer dryer, deep bed dryer, flat bed dryer, tray dryer, fluidized bed dryer, recirculatory dryer, LSU dryer and solar dryer - types of solar dryer
14. Material handling - material handling equipments- selection of material handling equipments. Belt conveyor - idlers - idler spacing - belt material - belt tension-working principle and selection.
15. Bucket elevator - head section - boot section - elevator legs - elevator belts- bucket drive mechanism - working principle and selection.
16. Screw conveyor - details - various shapes screw trough - capacity - horse power, Pneumatic conveyor - working principle and selection. - advantages and limitations.

#### **Practical schedule:**

1. Study of different types of greenhouses based on shape.
2. Determination of rate of air exchange in an active summer and winter cooling systems.
3. Determination of drying rate of agricultural products inside green house.
4. Study of greenhouse equipments.
5. Determination of engineering properties shape and size, bulk density and porosity of biomaterials.
6. Determination of moisture content of various grains by direct method - oven drying and infra red moisture methods.
7. Determination of moisture content of various grains by indirect method - moisture meter.
8. Performance evaluation of grain winnower
9. Performance evaluation of air screen cleaner
10. Study of fluidized bed dryer
11. Performance evaluation of tray dryer
12. Determination of capacity of a belt conveyor and its performance evaluation
13. Determination of capacity of a bucket conveyor and its performance evaluation
14. Field visit to greenhouse
15. Visit to post harvest laboratories.
16. Visit to Seed processing unit.
17. **FINAL PRACTICAL EXAMINATION**

#### **References:**

1. Singh Brahma and Balraj Singh., 2014. Advances in Protected Cultivation, New India Publishing Company.
2. Greenhouse Management for Horticulture crops -S.Prasad&U.Kumar., 2013. AGROBIOS (INDIA).
3. Greenhouse Management for Horticulture crops -SandhyaSharaf., 2012. Oxford Book Company.
4. Greenhouse for Homeowners and Gardeners - John W. Bartok, Jr., 2000. NRAES
5. Greenhouse Engineering - Robert A. Aldrich and John W. Bartok, Jr., 1994. NRAES

6. Sahay K.M and Singh K .K. Unit operations of agricultural processing. Vikas Publishing house Pvt. Ltd. New Delhi.
7. Chakraverty A. Post-harvest technology of cereals, Pulses and Oil seeds. published by Oxford & IBH publishers. New Delhi.
8. M.N.Dabhi and N.K. Dhamsananiya Agricultural Processing and food engineering (A basic approach) published by Kalyani Publisher. New Delhi.

## **AEN 302 MANAGEMENT OF BENEFICIAL INSECTS (1+1)**

### **Outcomes:**

- In-depth understanding importance of insects beneficial, biology, method of rearing, pests and diseases of honey bee and silkworm.
- Understanding Species of lac insect, morphology, biology, host plant, pollinator, weed killers and scavengers

### **Theory**

**Unit I:** Importance of beneficial Insects, Beekeeping and pollinators, bee biology, commercial methods of rearing, equipment used, seasonal management, bee enemies and disease. Bee pasturage, bee foraging and communication. Insect pests and diseases of honey bee. Role of pollinators in cross pollinated plants.

**Unit II:** Types of silkworm, voltinism and biology of silkworm. Mulberry cultivation, mulberry varieties and methods of harvesting and preservation of leaves. Rearing, mounting and harvesting of cocoons. Pest and diseases of silkworm, management, rearing appliances of mulberry silkworm and methods of disinfection.

**Unit- III:** Species of lac insect, morphology, biology, host plant, lac production – seed lac, button lac, shellac, lac- products. Identification of major parasitoids and predators commonly being used in biological control.

**Unit - IV:** Insect orders bearing predators and parasitoids used in pest control and their mass multiplication techniques. Important species of pollinator, weed killers and scavengers with their importance.

### **Practical**

Honey bee species, castes of bees. Beekeeping appliances and seasonal management, bee enemies and disease. Bee pasturage, bee foraging and communication. Types of silkworm, voltinism and biology of silkworm. Mulberry cultivation, mulberry varieties and methods of harvesting and preservation of leaves. Species of lac insect, host plant identification. Identification of other important pollinators, weed killers and scavengers. Visit to research and training institutions devoted to beekeeping, sericulture, lac culture and natural enemies. Identification and techniques for mass multiplication of natural enemies.

**Theory lecture schedule:**

1. Economic classification of insects 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 variations- Seasonal management of honey bees
4. Different types hives -Bee products- Bee enemies- predators and parasites
5. Bee diseases – bacteria, virus, fungi and protozoan
6. Equipments used in bee keeping
7. 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
8. Pests and diseases of mulberry
9. **Mid semester examination**
10. Types of silkworm - Mulberry silkworm – origin – classification based on voltinism, moultnism, geographical distribution and genetic nature
11. Characters of multivoltine races, bivoltine races, cross breeds and bivoltine hybrids – double hybrids– suitability for rearing in different seasons
12. Morphology and biology of silkworm – sexual dimorphism in immature and adult stages – silkworm genetics – chromosome number – sex limited characters in egg, larva and cocoon for grainage use
13. Methods of chawki and late age silkworm rearing- disinfections- pests and diseases of silkworms
14. Lac insect- biology-strains-Natural enemies of lac insect and lac products
15. Biological control – definition, parasitoids and predators and their role in pest management and mass production.
16. Biological weed control, pollinators, scavengers and soil builders

**Practical schedule:**

1. Identification, morphology and structural adaptations in honey bees
2. Different species of honey bees
3. Bee keeping appliances and seasonal management
4. Rearing of queen, worker and drone cell and colony organization
5. Bee enemies and diseases/ bee products
6. Mulberry nursery bed preparation – methods of planting - Pruning methods – leaf / shoot harvest– preservation of leaves.
7. Pests and diseases of mulberry

8. Different species of silkworms- Chawki and late age silkworm rearing
9. Appliances and disinfection in silkworm rearing
10. Pests and diseases of mulberry silkworm
11. Lac insect-life history, hosts and culturing of lac, natural enemies and lac products
12. Identification and mass culturing of different types of parasitoids
13. Identification and mass culturing of different types of predators
14. Mass production techniques of predators and parasitoids
15. Identification of weeds, and weed killers, pollinators, scavengers and soil builders
16. Visit to research and training institutions for bee keeping, sericulture, lac insect and natural enemies
- 17. Practical examination**

#### References:

1. David, B.V. and V.V. Ramamurthy. 2011. *Elements of Economic Entomology*, Namrutha Publications, Chennai, 386 p. {ISBN: 978-81-921477-0-3}
1. Pedigo, L.P. and M.E.Rice.1996.*Entomology and Pest Management*. Prentice-Hall of India Pvt Ltd, New Delhi. 812p. {ISBN-978-8120338869}
2. Dhaliwal, G.S. and R.Arora. 2001. *Integrated Pest Management – Concepts and approaches*. Kalyani publishers, New Delhi. 427p. {ISBN: 81-7663-904-4}
3. Dandin, S.B., J.Jayaswal and K. Giridhar.2003. *Hand book of Sericulture Technologies*. Central Silk Board, Bangalore, 287 p.
4. Singh.T. and Saratchandra,B.2004.Principles and techniques of silkworm seed production. Discovery publishing house, New Delhi.

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2. <http://www.ncipm.org.in/recent-publications.htm>
3. <http://www.ipmnet.org>
4. [www.silkbase.org](http://www.silkbase.org)
5. [www.papilo.ab.a.u.tokyo.ac.jp](http://www.papilo.ab.a.u.tokyo.ac.jp)



## **AEX 302 ENTREPRENEURSHIP DEVELOPMENT AND BUSINESS COMMUNICATION (1+1)**

### **Outcomes:**

- Understanding the importance of Entrepreneurial process and Entrepreneurship Opportunities.
- Understanding Managerial Functions – I & II and functional area of management.

### **Theory**

#### **Unit I – Entrepreneur and Entrepreneurial process**

Concept and Types of Entrepreneurship - Importance of Entrepreneurship, Characteristics of Entrepreneurs and Entrepreneurial Skills - Entrepreneurial process.

#### **Unit II – Entrepreneurship Opportunities**

Government policy and programs and institutions for entrepreneurship development, Impact of economic reforms on Agribusiness/ Agrienterprises, Entrepreneurial Development Process, Opportunities for agri-entrepreneurship and rural enterprise, SWOT Analysis.

#### **Unit III – Managerial Functions – I**

Planning, managing and setting up of an enterprise – Financing for enterprise : Venture capital, contract farming, Joint venture, PPP. Developing organizational skill (controlling, supervising, problem solving, monitoring & evaluation)

#### **Unit IV – Managerial Functions – II**

Business Leadership Skills (Communication, direction and achievement motivation), problem solving skill.

#### **Unit V – Functional Areas of Management**

Supply Chain Management – Drivers and flows and Total Quality Management – Meaning and Principles, Project Planning Formulation and report preparation

### **Lecture Schedule**

1. Concept of Entrepreneurship and Types of Entrepreneurship
2. Characteristics of Entrepreneurs and Entrepreneurial Skills
3. Entrepreneurial process — Importance of Entrepreneurship
4. Government policy and programs and institutions for entrepreneurship development.
5. Impact of economic reforms on Agribusiness/ Agri-enterprises.
6. Opportunities for agri-entrepreneurship and rural enterprise, SWOT Analysis
7. Entrepreneurial Development Process, Planning, managing and setting up of an enterprise.
8. Financing for enterprise: Venture capital, contract farming, Joint venture, PPP.
9. **Mid Semester**
10. Developing organizational skill (controlling, supervising, problem solving, monitoring & evaluation)
11. Business Leadership Skills (Communication, direction )

12. Motivation, hypothesis behind motivation, entrepreneurial motivation training.
13. Business Leadership Skills - controlling, supervising, problem solving.
14. Managerial skills - Organizing. Communication, direction and Problem solving skill.
15. Supply Chain Management – Importance, Drivers and flows and Total Quality Management – Meaning and Principles
16. Project Planning Formulation and report preparation

### **Practical**

Assessing entrepreneurial traits, practicing business communication, problem solving skills, managerial skills and achievement motivation, exercise in creativity, time audit through planning, monitoring and supervision, identification and selection of business idea, preparation of business plan and proposal writing, visit to entrepreneurship development institute and entrepreneurs.

### **Practical Schedule**

1. Assessment of entrepreneurial traits
2. Practicing business communication
3. Understanding about Problem solving skills through case analysis - I
4. Understanding about Problem solving skills through case analysis - II
5. Discussion and Understanding achievement motivation by case analysis
6. Exercise in creativity
7. Understanding Time audit through planning by case analysis.
8. Visit to entrepreneurship development institutes
9. Visit to firms / discussion with entrepreneurs
10. Exercise on SWOT Analysis of Agribusiness enterprises in India - I
11. Exercise on SWOT Analysis of Agribusiness enterprises in India - II
12. Identification of new business opportunities.
13. Preparation of business plan and proposal writing - I
14. Preparation of business plan and proposal writing - II
15. Presentation and evaluation of the business plan - I
16. Presentation and evaluation of the business plan - II
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.
- 5) Vasant Desai. 2000. Dynamics of Entrepreneurial Development and Management, Himalaya Publishing House, New Delhi.

## E- References

1. [www.ediindia.org/](http://www.ediindia.org/)
2. [iie.nic.in/](http://iie.nic.in/)
3. [msme.gov.in/](http://msme.gov.in/)
4. [niesbudtraining.org](http://niesbudtraining.org)
5. [www.nimsme.org/](http://www.nimsme.org/)
6. [www.nsic.co.in/](http://www.nsic.co.in/)
7. <https://www.nabard.org/>

## **AGR 304      PRACTICAL CROP PRODUCTION – II (*RABI* CROPS)      (0+1)**

### **Outcomes:**

- Each student will be allotted a minimum land area of 100/200 m<sup>2</sup>. He / she will do all field operations in the allotted land from field preparation to harvest and processing.
- Field preparation, seed, treatment, nursery raising, sowing, nutrient, water and weed management and management of insect-pests diseases of crops, harvesting, threshing, drying winnowing, storage and marketing of produce.
- Rice (Transplanted or direct sown)

### **Transplanted rice:**

- Rice ecosystems - Climate and weather - Seasons and varieties of India.
- Preparation of nursery - Application of manures to nursery - seed treatment - Forming nursery beds and sowing seeds - Weed management and plant protection to nursery.
- Preparation of main field - Application of organic manures - Green manuring - Bio-fertilizers - Pulling out seedlings and transplanting - Rajarajan 1000 (SRI) - Application of herbicides - Water management - Nutrient management - Plant protection measures - Mechanization in rice cultivation - Recording growth, yield attributes and yield.
- Harvesting, threshing, drying and cleaning the produce - Working out cost of cultivation and economics.

### **Practical Schedule:**

1. Selection of nursery area, preparation of nursery, application of manures and fertilizer to nursery
2. Study and practice of green manuring and bio-fertilizer application in rice
3. Acquiring skill in seed treatment, seed soaking and incubation, nursery sowing and management
4. Study and practice of main field preparation and puddling operations
5. Practicing of field preparatory operations – sectioning of field bunds and plastering, leveling and basal application of fertilizers

6. Practicing transplanting techniques in lowland rice/ exposure to mechanized transplanting
7. Estimation of plant population and acquiring skill in gap filling and thinning
8. Study of weeds and weed management in rice/ exposure to mechanized weeding
- 9. MID-SEMESTER EXAMINATION**
10. Acquiring skill in nutrient management and practicing top dressing techniques
11. Study of water management practices for lowland rice
12. Observation of insect pests and diseases and their management
13. Recording growth and other related characters of rice
14. Estimation of yield and yield parameters in rice
15. Harvesting, threshing and cleaning of the produce/ exposure to mechanized harvesting & threshing.
- 16. Preparation of balance sheet including cost of cultivation and net returns per student**
- 17. FINAL PRACTICAL EXAMINATION**

#### **References:**

1. Ahlawat, I. P. S. , Om Prakash and G. S. Saini. 1998. Scientific Crop Production in India. Rama Publishing House, Meerut.
2. Chidda Singh. 1997. Modern techniques of raising field crops. Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi.
3. Crop Production Guide. 2012. Directorate of Agriculture, Chennai and Tamil Nadu Agricultural University, Coimbatore.
4. Rajendra Prasad. 2004. Text Book on Field Crop Production, Indian Council of Agrl. Research, New Delhi.
5. K Annadurai and B Chandrasekaran. 2009. A Text Book Of Rice Science. Scientific Publishers.
6. Reddy,S. R. 2012. Agronomy of field crops. Kalyani publishers, New Delhi.
7. ICAR 2015. Hand book of Agriculture. Indian Council of Agriculture, New Delhi.

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3. [www. drrindia. org](http://www.drrindia.org)

### **AGR 305      PRINCIPLES OF ORGANIC FARMING (1+1)**

#### **Outcomes:**

- In-depth understanding impacts of green revolution, organic farming and nutrient management.
- Understanding principles of pest management, organic Certification, marketing, exports opportunities and ITK in organic agriculture

## **Theory**

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

Types of farming – Impacts of green revolution farming – Fate of agro chemicals in ecosystem.

### **Unit II: 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 III: Nutrient 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

### **Unit IV: Pest and disease management in organic farming**

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-inoculants - quality analysis of inputs and products - grading, packaging, post-harvest management – visit to organic farms, market outlets and organic certification centers.

## **Lecture Schedule**

1. Farming – types of farming
2. Impacts of green revolution farming
3. Fate of agro chemicals in ecosystem.
4. Ecology and Principles of ecology. Biodiversity: importance and measure to preserve biodiversity

5. Organic farming: Definition - Scope - Principles and concepts - History of organic farming
6. Organic carbon: status and improvement strategies – conservation tillage.
7. Principles of nutrient management in organic farm - Organic sources and potentials – on farm and off farm sources – organic waste recycling methods
8. Soil and crop management - inter cropping, crop rotation, green manures, cover crops, mulching - bio fertilizers
9. **MID-SEMESTER EXAMINATION**
10. Principles of pest management in organic farm - Bio intensive pest and diseases management - physical, cultural, mechanical and biological methods
11. Non-chemical weed management methods: preventive, physical, cultural, mechanical and biological control measures.
12. Organic certification – NPOP guidelines
13. Certification agencies in India – crop production standards
14. Quality considerations - labeling and accreditation process - marketing and export opportunities.
15. Indigenous Technical Knowledge (ITK) in organic agriculture – Integrated farming system approach
16. Benefits and problems of organic farming – economic evaluation of organic production systems

### **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 ecosystems
15. Organic certification procedures
16. Visit to organic farms, market outlets and organic certification centers
17. **PRACTICAL EXAMINATION**

### **References**

1. Nicholas Lampkin 1994. Organic farming. Farming press London.
2. Arunkumar Sharma 2008. A Hand book of organic farming. Agrobios Publishers.
3. Dahama, A.K.2009. Organic farming for sustainable agriculture, Agrobros publishers.
4. Veeresh, G.K. 2010. Organic farming, Cambridge university press.

5. SP. Palaniappan and K Annadurai. 2008. Organic Farming: Theory and Practice. 2008. Scientific Publishers.
6. Stockdale, E *et al.*, 2000. Agronomic and environmental implications of organic farming systems. *Advances in Agronomy*, 70, 261-327

**FSN 301**

**PRINCIPLES OF FOOD SCIENCE AND NUTRITION**

**2+0**

**Outcomes:**

- In-depth understanding classification and scope of foods, Carbohydrate, Protein and Fat, Vitamin and Mineral Nutrition
- Understanding preservation and processing of Food, requirements of Food Quality and Safety

**Theory**

**Unit I: Principles of Food Science and Nutrition**

Food Science - definition – classification of foods – functional and nutritional classification. Food groups and food pyramid. Methods of cooking - moist, dry and microwave - principles, merits and demerits. Importance and scope of nutrition – relation of nutrition to health.

**Unit -II: Carbohydrate, Protein and Fat**

Carbohydrate – classification, functions, digestion and absorption, sources and Recommended Dietary allowance (RDA). Energy value of foods – determination. Protein – classification, functions digestion and absorption, sources and requirements. Protein quality of foods – supplementary value of protein. Fat - classification functions, digestion and absorption, sources and requirements. Rancidity – types of rancidity and prevention. Deficiency states of protein, carbohydrate and fat nutrition – signs and symptoms.

**Unit III: Vitamin and Mineral Nutrition**

Fat Soluble vitamins – A, D, E and K- functions, sources, requirements and deficiency. Water soluble vitamins – thiamine , riboflavin , niacin, pyridoxine, folic acid, cyanacobalamin, biotin, pantothenic acid ascorbic acid – functions, sources, deficiency and requirements. Minerals - calcium, iron, phosphorus, iodine, magnesium, zinc, sodium, potassium, fluorine and chlorine – functions, sources, deficiency and requirements. Importance of water – maintenance of electrolyte balance. Dietary fibre - importance, health benefits, sources and requirements.

**Unit IV: Food Preservation and Processing**

Introduction – preservation by sugar - processing of jam, squash, jelly, marmalade and beverages. Preservation by using salt, chemicals, dehydration technology, canning technology, preservation by low temperature and irradiation techniques. Processing of puffed, flaked and extruded products. Quality control of raw and processed products.

## Unit V: Food Quality and Safety

Food packaging materials – requirements – methods – nutrition labeling. Food adulterants and their detection methods. Food laws and regulations and quality control standards - FSSAI, ISO, EU standards, FDA, HACCP and Codex Alimentarius Commission.

### Lecture Schedule

1. Food Science – definition, scope and classification, food pyramid
2. Methods, merits and demerits of moist heat, dry heat and microwave cooking of foods.
3. Importance and scope of nutrition and the relation of nutrition to health.
4. Concepts of food science (density, phase change, pH, osmosis, surface tension, colloidal system *etc.*)
5. Carbohydrate – classification, functions, digestion and absorption, deficiency symptoms, sources and requirements.
6. Protein – classification, functions, digestion and absorption, deficiency symptoms, sources and requirements.
7. Protein quality – supplementary value of protein.
8. Fat - classification, functions, digestion and absorption, deficiency symptoms, sources and requirements.
9. Rancidity – types and prevention methods.
10. Determination of energy value of foods.
11. Fat soluble vitamins – A, D, E and K – functions, deficiency symptoms, sources and requirements.
12. Water soluble vitamins - thiamine, riboflavin, niacin, pyridoxine, folic acid, cyanacobalamin, biotin, pantothenic acid, ascorbic acid – functions, deficiency symptoms, sources and requirements.
13. Minerals – calcium, iron, phosphorus, potassium – functions, sources, requirements and deficiency diseases.
14. Minerals –iodine, magnesium, zinc, sodium, fluorine and chlorine – functions, sources, requirements and deficiency diseases.
15. Importance of water and maintenance of electrolyte balance.
16. Health benefits of fibre, requirements and sources
17. **MIDSEMESTER EXAMINATION**
18. Energy metabolism
19. RDA and factors affecting RDA, RDA for various age groups.
20. Assessment of Nutritional status – Anthropometric, clinical, biophysical, functional, biochemical dietary assessments and vital health statistics
21. Balanced and modified diets, menu planning
22. New trends in food science and nutrition
23. Principles and methods of food processing and preservation (use of heat and low temperature)
24. Methods of food processing and preservation (use of chemicals, drying and radiation)
25. Types of dryers



26. Preservation by using sugar (jam, jelly, squash and marmalade), preservation by using salt (brining and pickling) and use of preservatives in food preservation.
27. Production of fermented food
28. Food microbiology (Bacteria, yeast, moulds spoilage of fresh and processed food)
29. Browning reaction of fruits and vegetables.
30. Food packaging – importance, types of packaging materials and nutrition labeling.
31. Common food adulterants and their detection.
32. Food laws and regulations and quality control standards - FSSAI, ISO, EU standards, FDA, HACCP and Codex Alimentarius Commission.

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1. Srilakshmi, B. 2005. Food Science. New Age International (P) Ltd., Publishers, New Delhi.
2. Srivastava, R.P., and Sanjeevkumar. S. 2013. Fruit and Vegetable preservation. International Book Distributing Co. Lucknow.
3. Srilakshmi .B. 2015. Nutrition Science. New Age International Pvt. Ltd. New Delhi.
4. The Indian Journal of Nutrition and Dietetics
5. Journal of Food Science and Technology
6. Critical Reviews of Food Science and Nutrition
7. [www.cellinteractive.com](http://www.cellinteractive.com)
8. [www.nutrition.org.uk](http://www.nutrition.org.uk)
9. [www.fnict.nal.usda.gov](http://www.fnict.nal.usda.gov)
10. [www.myfooddiary.com](http://www.myfooddiary.com)

## GBP 301 CROP IMPROVEMENT (2+1)

### Outcomes:

- In-depth understanding the origin, distribution, conservation of species in cereals, millets, pulses, oilseeds, fibers and vegetables.
- Understanding the importance of Intellectual Property, Maintenance breeding and IPR Issues

## THEORY

### Unit I: Breeding Cereals

Centers of origin, distribution of species, wild relatives in different cereals, pulses, oilseeds; Plant genetic resources, its utilization and conservation; Floral biology; study of genetics of qualitative and quantitative characters; Major breeding objectives and procedures including conventional and modern innovative approaches for development of hybrids and varieties for yield, adaptability, stability, abiotic and biotic stress tolerance and quality (physical, chemical, nutritional); Ideotype concept and climate resilient crop varieties for future in the following crops.

Cereals and Millets: Rice, Wheat, Maize, Sorghum, Pearl millet and Finger millet.

## **Unit II: Breeding Pulses and Oilseeds**

Centers of origin, distribution of species, wild relatives in different cereals, pulses, oilseeds; Plant genetic resources, its utilization and conservation; Floral biology; study of genetics of qualitative and quantitative characters; Major breeding objectives and procedures including conventional and modern innovative approaches for development of hybrids and varieties for yield, adaptability, stability, abiotic and biotic stress tolerance and quality (physical, chemical, nutritional); Ideotype concept and climate resilient crop varieties for future in the following crops.

**Pulses:** Red gram, Bengal gram, Green gram, Black gram, Cowpea and Soybean. Oilseeds: Groundnut, Sunflower, Gingelly, Castor, Rape and Mustard.

## **Unit III: Breeding Cash crops and Fodder crops**

Centers of origin, distribution of species, wild relatives in different cereals, pulses, oilseeds; Plant genetic resources, its utilization and conservation; Floral biology; study of genetics of qualitative and quantitative characters; Major breeding objectives and procedures including conventional and modern innovative approaches for development of hybrids and varieties for yield, adaptability, stability, abiotic and biotic stress tolerance and quality (physical, chemical, nutritional); Ideotype concept and climate resilient crop varieties for future in the following crops.

**Fibres:** Cotton, Mesta and Jute; Sugars and starches: Sugarcane and Potato; Fumitories: Tobacco and Areca nut; Fodder: Guinea grass, Napier grass, Cumbu – Napier hybrids, Lucerne and *Stylosanthes*.

## **Unit IV: Breeding Horticultural crops**

Centers of origin, distribution of species, wild relatives in different cereals, pulses, oilseeds; Plant genetic resources, its utilization and conservation; Floral biology; study of genetics of qualitative and quantitative characters; Major breeding objectives and procedures including conventional and modern innovative approaches for development of hybrids and varieties for yield, adaptability, stability, abiotic and biotic stress tolerance and quality (physical, chemical, nutritional); Ideotype concept and climate resilient crop varieties for future in the following crops.

**Vegetable crops:** Bhendi, Tomato, Brinjal, Chilli, Cabbage, Cauliflower, Radish, Amaranthus, Drumstick, Ridge gourd, Bottle gourd, Bitter gourd and Cucumber. Spices and Condiments: Onion, Garlic, Turmeric and Ginger. Fruit crops: Mango, Papaya, Banana and Guava. Flower crops: Rose and Jasmine

## **Unit V: Maintenance breeding and IPR Issues**

All India Coordinated Crop Improvement Projects. Procedure for release of new varieties; stages in seed multiplication; steps in nucleus and breeder seed production. Varietal rundown and renovation. Participatory plant breeding. Intellectual Property rights issues. Protection of plant varieties under UPOV and PPV & FR Act of India. Plant breeder's rights, Registration of plant varieties under PPV & FR Act 2001. Breeders right, researcher rights and farmers rights.

## **PRACTICAL**

Observation on floral biology – anthesis and pollination – selfing – crossing techniques – observation on cultivated germplasm, wild species – Experimental design – handling segregating generations- Yield trials in following crops- Rice, Maize and Sorghum, Pearl millet and Finger millet, Red gram, Bengal gram, Green gram, Black gram, Cowpea and Soybean, Groundnut and Sunflower, Sesame and Castor, Cotton, Jute, Sugarcane, Potato, Guinea grass, Napier grass, Cumbu–Napier hybrids, Lucerne, *Stylosanthes*, Bhendi, Brinjal, Tomato, Chilli, Cabbage, Cauliflower, Radish, Amaranthus, Ridge gourd, snake gourd, Bitter gourd, Cucumber, Radish, Onion, Garlic, Turmeric, Ginger, Mango, Papaya, Banana, Guava, Rose and Jasmine. Nucleus and Breeder seed production in field crops. Visit to AICRIP and hybrid Seed production plots of different crops.

## **Theory Lecture schedule**

Centers of origin, distribution of species, wild relatives in different cereals, pulses, oilseeds; Plant genetic resources, its utilization and conservation; Floral biology; study of genetics of qualitative and quantitative characters; Major breeding objectives and procedures including conventional and modern innovative approaches for development of hybrids and varieties for yield, adaptability, stability, abiotic and biotic stress tolerance and quality (physical, chemical, nutritional); Ideotype- concept and climate resilient crop varieties for future in the following crops:

1. Cereals: Rice.
2. Cereals: Rice.
3. Cereals: Wheat
4. Cereals : Maize
5. Cereals: Sorghum
6. Cereals: Pearl millet and Finger millet,
7. Pulses: Red gram and Bengal gram
8. Pulses: Green gram and Black gram
9. Pulses: Soybean and Cowpea
10. Oilseeds: Groundnut and Gingelly
11. Oilseeds: Rapeseed and Mustard
12. Oilseeds: Castor and Sunflower
13. Fibres: Cotton and Jute
14. Sugars and starches: Sugarcane and Potato
15. Forrage Grasses: Guinea grass, Napier grass, Cumbu-Napier hybrids
16. Forage legumes: Lucerne and *Stylosanthes*
17. **Mid Semester Examination**
18. Fumitories and Narcotics: Tobacco and Areca nut
19. Vegetable crops: Bhendi and Brinjal,
20. Vegetable crops: Tomato and Chilli
21. Vegetable crops: Cabbage and Cauliflower
22. Vegetable crops: Radish and Amaranthus and Drumstick
23. Vegetable crops: Ridge gourd and Bottle gourd
24. Vegetable crops: Bitter gourd and Cucumber

25. Spices and Condiments: Onion and Garlic
26. Spices and Condiments: Turmeric and Ginger
27. Fruit crops: Mango and Papaya
28. Fruit crops: Banana and Guava
29. Flower crops: Rose and Jasmine.
30. All India Coordinated Crop Improvement Projects. Procedure for release of new variety.
31. Stages of seed production. Nucleus and Breeder seed production of field crops. Varietal rundown and renovation.
32. Intellectual property and IPR Issues. Protection of plant varieties under UPOV and PPV & FR Act of India, Plant breeder's rights. Registration of plant varieties under PPV & FR Act, 2001. Breeders, researcher and farmers rights.

### **Practical schedule**

Observation on floral biology – anthesis and pollination – selfing – crossing techniques – observation on cultivated germplasm, wild species – Experimental design – handling segregating generations- Yield trials in following crops.

1. Rice
2. Wheat and Maize
3. Sorghum, Pearl millet and Finger millet
4. Red gram, Bengal gram, Cowpea and Soybean
5. Green gram, Black gram and Groundnut
6. Sesamum, Sunflower, Mustard and Castor
7. Cotton and Jute
8. Sugarcane and Potato
9. Guinea grass, Cumbu – Napier hybrids, Lucerne and *Stylosanthes*
10. Bhendi, Brinjal, Tomato and Chilli
11. Cabbage, Cauliflower, Radish, Amaranthus and Drumstick
12. Ridge gourd, Bottle gourd, Bitter gourd and Cucumber
13. Onion, Garlic, Turmeric and Ginger
14. Mango, Papaya, Banana and Guava
15. Rose and Jasmine
16. Visit to AICRP and Hybrid seed production plots of different field crops

### **17. Final Practical Examination**

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**HOR 312**

**POST-HARVEST MANAGEMENT AND VALUE ADDITION OF  
FRUITS AND VEGETABLES**

**1+1**

**Outcomes:**

- In-depth understanding the principles and importance of postharvest technology and physiology of ripening in fruits and vegetables
- Understanding preservation, dehydration and canning techniques in fruits and vegetables

**Theory**

**UNIT I - Principles and importance of postharvest technology**

Importance of fruits and vegetables, extent and possible causes of post harvest losses; Pre-harvest factors affecting postharvest quality, maturity, ripening and changes occurring during ripening.

**UNIT II - Post harvest handling and physiology of ripening**

Respiration and factors affecting respiration rate; Role of ethylene; Post harvest disease and disorders; Heat, chilling and freezing injury; Harvesting and field handling; Storage (ZECC, cold storage, CA, MA, and hypobaric).

### **UNIT III - Value addition and preservation**

Value addition concept; Principles and methods of preservation; Intermediate moisture food- Jam, jelly, marmalade, preserve, candy – Concepts and Standards; Fermented and nonfermented beverages.

### **UNIT IV– Value added products and dehydration techniques**

Tomato products- Concepts and Standards; Drying/ Dehydration of fruits and vegetables – Concept and methods, osmotic drying.

### **UNIT V – Canning technology**

Canning – Concepts and Standards, Packaging of products.

### **PRACTICAL**

Applications of different types of packaging containers for shelf life extension, Effect of temperature on shelf life and quality of produce, Demonstration of chilling and freezing injury in vegetables and fruits, Extraction and preservation of pulps and juices, Preparation of jam, Preparation of Jelly, Preparation of RTS, Preparation of Nectar, Preparation of Squash, Osmotically dried products, Fruit bar and Candy and Tomato products, Canned products, Quality evaluation of products — physico-chemical and sensory, Visit to processing unit/ industry

### **Lecture schedule**

1. Scope and Importance of post-harvest technology of fruits and vegetables - Extent and possible causes of post-harvest losses - Causes of post-harvest losses.
2. Pre-harvest factors affecting postharvest quality, maturity, ripening and shelf life of fruits and vegetables – Environmental factors (Temperature, Light, Rainfall, Wind, Relative humidity) – Cultural factors – (Rootstock, Variety, Mineral nutrients, growth regulators, Irrigation, pruning, thinning, girdling) – Maturity – Pest and diseases.
3. Changes occurring during ripening – Ripening definition - Climacteric and non-climacteric fruits – Metabolic changes - Maturation of seeds – Colour – Texture - Changes in carbohydrates- Changes in aromatic volatiles - Changes in organic acids – Fruit abscission – Changes in respiration rate – Development of surface waxes – Changes in tissue permeability.
4. Causes for deterioration of harvested fruits and Vegetables -Respiration and factors affecting respiration rate – Transpiration and factors affecting transpiration - Ethylene – Mechanical damage – Pest and Diseases.
5. Post harvest diseases and disorders - Heat, chilling and freezing injury.
6. Harvesting and field handling – Methods of harvesting – Post harvest handling – Pre-cooling - Sorting and grading – Disinfestation – Post harvest treatments (Waxing, Wrapping, de-greening, ripening).
7. Storage – Methods of storage – Traditional storages (In-situ, pit storage, high altitude, clamp storage, wind breaks, cellars, barns, Night ventilation, Evaporative cool storage ZECC) - Improved storage methods (Refrigerated storage, modified atmospheric storage, controlled atmospheric storage, hypobaric storage).

8. Packaging of products - Definition – Properties of good packaging material – Different packaging materials for fresh fruits and vegetables for export – Cushioning materials – Purpose – Characteristics of cushioning material.
9. **MID SEMESTER EXAMINATION**
10. Value addition – Concept – Scope and importance of fruit preservation in India – Status of fruit preservation in India. Principles and methods of preservation – Principles of preservation – Preservation methods – High temperature, low temperature, drying, filtration, chemicals, food additives, fermentation, carbonation, antibiotics, irradiation etc.
11. Intermediate moisture foods - Jam, jelly, marmalade – Problems in Jam making important considerations and problems in Jelly making- Problems in marmalade making.
12. Preserve, candy – Concepts and Standards – Flow chart for manufacturing of preserve and candy – Problems in preservation of preserve and candied fruits – Glazed fruits/vegetables.
13. Fruit beverages –Fermented (Juices, Ready to serve, Nectar, cordial, Squash, crush, Syrup, Fruit Juice concentrate, Fruit Juice, Powder, Carbonated beverages) and non-fermented beverages (Wine, Champagne, Port, Sherry, Tokay, Muscat, Perry, Nira, Feni, Cider) – Preparation and preservation of unfermented fruit beverages.
14. Tomato processing - Concepts and Standards – Tomato juice – Tomato puree and paste – Tomato sauce/ketchup- Tomato chutney/pickle –Tomato cocktail – Tomato soup – Canned tomatoes.
15. Drying/dehydration of fruits and vegetables – Factors affect the rate of drying – Advantages of dehydration over sun drying – Process of drying/dehydration of fruits and vegetables – Spoilage of dried fruits and vegetables - Freezing – Methods of freezing.
16. Canning of fruits and vegetables – Selection of fruits and vegetable - Causes of spoilage of canned foods – Testing for defects - Containers for packing of canned products – Tin containers, glass containers.

### **Practical Schedule**

1. Applications of different types of packaging containers for shelf life extension.
2. Effect of temperature on shelf life and quality of produce.
3. Demonstration of chilling and freezing injury in vegetables and fruits.
4. Extraction and preservation of pulps and juices.
5. Preparation of jam.
6. Preparation of jelly.
7. Preparation of RTS.
8. Preparation of nectar.
9. Preparation of squash.
10. Preparation of osmotically dried products.
11. Preparation of fruit bar and candy.
12. Preparation of tomato sauce.
13. Preparation of tomato ketchup.

14. Preparation of canned products.
15. Quality evaluation of products - (physic-chemical and sensory).
16. Visit to processing unit/ industry.
17. **PRACTICAL EXAMINATION**

## References

1. Rathore, N.S., Mathur, G.K., Chasta, S.S. 2012. Post-harvest Management and Processing of Fruits and Vegetables. ICAR, New Delhi.
2. Srivastava, R.P. and Sanjeev Kumar. 2002. Fruit and Vegetable Preservation: Principles and Practices. International Book Distribution Company, Lucknow.
3. Giridharilal, G.S., Siddappa and Tondon, G.L. 2007. Preservation of Fruits and Vegetables. ICAR, New Delhi.
4. Mitra, S.K. 2005. Post Harvest Physiology and Storage of Tropical and Subtropical Fruits. CABI Publishers, Kolkatta.

## **PAT 302      Diseases of Field and Horticultural crops and their management-II    (2+1)**

### Outcomes:

- In-depth understanding the Etiology, symptoms, mode of spread, survival, epidemiology & integrated management of important diseases of Cereals, Cash and Vegetable crops.
- Understanding the Etiology, symptoms, mode of spread, survival, epidemiology & integrated management of important diseases of Plantation crops & mushroom

### Theory

Etiology, symptoms, mode of spread, survival, epidemiology and integrated management of important diseases of the following crops

#### **Unit I: Diseases of cereals, pulses and oil seed crops**

Cereals: Wheat - Pulses: Chick pea and lentil - Oil seeds - Sunflower and mustard

#### **Unit II: Diseases of cash crops and fruit crops**

Cash crops: Cotton and sugarcane - Fruit crops: Mango, citrus, grapevine, apple, peach, plum and pear

#### **Unit III: Diseases of vegetable and spice crops**

Vegetable crops: Cucurbits, peas, potato, cassava, colacasia and yam - Post harvest diseases of fruits and vegetables - Spice crops: Chillies, ginger, turmeric, onion, garlic, coriander, cardamom



#### **Unit IV: Diseases of plantation and flower crops**

Plantation crops: Black pepper and betelvine - Flower crops: Rose, jasmine, marigold, crossandra, chrysanthemum, tube rose, carnation, lillium and orchids

#### **Unit V: Mushroom cultivation**

Importance of mushroom - Cultivation of oyster mushroom, milky mushroom, paddy straw mushroom and button mushroom – Constraints in mushroom cultivation - Post harvest technology

#### **PRACTICAL**

Study of symptoms and host parasite relationship of the important diseases of wheat, chick pea, lentil, sunflower, mustard, cotton, sugarcane, mango, citrus, grapevine, apple, peach, plum, pear, cucurbits, potato, peas, cassava, colacasia, yam, chillies, turmeric, ginger, onion, garlic, coriander, cardamom, black pepper, betelvine, rose, jasmine, marigold, crossandra, chrysanthemum, tube rose, carnation, lillium, orchids and cultivation of button mushroom, oyster mushroom, milky mushroom and paddy straw mushroom.

#### **THEORY**

Etiology, symptoms, mode of spread, survival, epidemiology and integrated management of

1. Diseases of wheat
2. Diseases of chickpea and lentil
3. Diseases of sunflower and mustard
4. Diseases of cotton
5. Diseases of sugarcane
6. Diseases of mango
7. Diseases of citrus
8. Diseases of grapevine
9. Diseases of apple
10. Diseases of peach, plum and pear
11. Diseases of cucurbits
12. Diseases of potato
13. Diseases of peas
14. Diseases of cassava, colacasia and yam
15. Post-harvest diseases of fruits and vegetables
16. Diseases of chillies
17. **Mid semester examination**
18. Diseases of turmeric and ginger
19. Diseases of onion and garlic
20. Diseases of cardamom and coriander

21. Diseases of black pepper and betel vine
22. Diseases of rose and jasmine
23. Diseases of marigold, crossandra and chrysanthemum
24. Diseases of tube rose and carnation
25. Diseases of lillium and orchids
26. Mushroom - Medicinal and nutritional values of mushroom
27. Mushroom spawn preparation
28. Cultivation of oyster mushroom and milky mushroom
29. Cultivation of paddy straw mushroom
30. Substrates for button mushroom - Compost preparation
31. Cultivation of button mushroom
32. Constraints in mushroom cultivation and post-harvest technology

## **PRACTICAL**

### **Study of symptoms and host-parasite relationship of:**

1. Diseases of wheat
2. Diseases of chick pea, lentil, sunflower and mustard
3. Diseases of cotton and sugarcane
4. Diseases of mango
5. Diseases of citrus and grapevine
6. Diseases of apple, peach, plum and pear
7. Diseases of cucurbits
8. Diseases of potato and peas
9. Diseases of cassava, colacasia and yam
10. Field visit/ exposure visit to fruits , vegetables and plantation crops / mushroom unit
11. Diseases of chillies, turmeric and ginger
12. Diseases of onion and garlic
13. Diseases of coriander, cardamom, black pepper and betelvine
14. Diseases of flower crops
15. Cultivation of oyster, milky and paddy straw mushroom
16. Cultivation of button mushroom
17. Final practical examination

## **Reference Books**

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2. Rangasawmi ,G and Mahadevan, A. 1998. Diseases of crop Plants in India, Prentice Hall of India Pvt. Ltd., New Delhi

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## SEMESTER VII

Sl.No.	Course No.	Course Title	Cr.Hr.
1.	RAE 401	Rural Agricultural Work Experience and Agro-Industrial Attachment (RAW&AIA)	0+20
2.	PJN 401	Educational Tour - II (All India)*	0+1
TOTAL			0+21

\* Non-Gradual Course

**RAE 401 Rural Agricultural Works Experience and Agro-Industrial Attachment  
(RAWE & AIA) (0+20) – 120 days**

**Outcome:**

- Ensuring and assuring employability and develop entrepreneurs among agriculture graduates.

Student READY (Rural Entrepreneurship Awareness Development Yojana) programme is a new initiative of Indian Council of Agricultural Research to reorient graduates of Agriculture and allied subjects for ensuring and assuring employability and develop entrepreneurs. As per the V Dean's committee recommendations the responsibility of organising RAWE & AIA rests with all the departments of the college and it should be a multi disciplinary approach involving all the faculties of different disciplines with the following modules.

No.	Activities	No. of Days	Credit Hours
1.	General orientation & On campus training by different faculties	6	0+11
2.	Village attachment	59	
3.	Attachment with Department of Agriculture / KVK / Research Station attachment / NGO attachment- including evaluation	24	0+4
4.	Plant clinic - including evaluation	7	0+1
5.	Agro-Industrial Attachment & Project Report Preparation, Presentation and Evaluation	24	0+4
<b>Total days for RAWE &amp; AIA</b>		<b>120</b>	<b>0+20</b>

**(All Sundays and holidays are working days)**

**I. Village Attachment (0+10) 200 Marks - Duration 59 days**

The village attachment is designed to understand the rural situations, status of agricultural technologies adopted by farmers, prioritize the farmer's problems and to develop skills and attitude of working with farm families for overall development in rural area. This will impart diagnostic and remedial knowledge to the students relevant to real field situations through practical training. The detailed training programme during the village attachment of students is given below.

Sl.No.	Activity	No. of Days
1	Orientation, survey of village and Settlement in village	6
2	Agronomical interventions including seed production	6
3	Plant protection interventions	6
4	Soil improvement interventions (Soil sampling and testing)	6
5	Fruit, Vegetable and flower production interventions	6
6	Food processing and storage inventions	5
7	Animal production interventions	5
8	Extension and transfer of technology activities	6
9	Economics and farm management interventions	6
10	Report preparation and evaluation	7
<b>Total</b>		<b>59 days</b>

### **I. Intervention wise Schedule and List of activities**

#### **Orientation and Village Survey: (AEX) – 6 days**

Conducting PRA (Participatory Rural Appraisal), Techno-socioeconomic survey of village and group discussion with village leaders, assessing the overall condition of village, resource availability and its utilization, problems of labour and employment and other important economic aspects, study the host farmer and weather data and documentation of ITKs.

#### **Agronomical, seed production Interventions: (AGR, PBG, SST) – 6 days**

Cost of cultivation, Maintenance of daily operations (any one major crop), Documentation of Indigenous Technical Knowledge (ITK) practices followed in cultivation of agronomical crops in the village, Seed Production of Field/Horticultural Crops, Collection of Germplasm (Wild Species, Landraces, Local Varieties etc.). Conducting demonstrations viz. integrated weed management, advanced crop production technology from preparatory tillage to post harvest technology and marketing in major crops, seed production, irrigation systems (Sprinkler / Drip / Sub-surface/ automation / fertigation), use of apps for crop production.

#### **Plant Protection Interventions: (ENT, PAT, AGM & ANM) – 6 days**

General position of plant pest and diseases in a village, Pest and disease management on Host farmer's field, Monitoring for incidence and determining extent of damage and integrated pests and diseases management (IPDM) of major crops of host

farmer. Conducting demonstrations / discussions in on IPDM technology for major crops, identification of pests and beneficial insects, seed treatment (chemical and biological), assessment of economic threshold level and damage due to pests and diseases and their control measures, handling, use and maintenance of agro-chemicals and spraying and dusting equipment, identification and control of stored grain pests, Neem Seed Extract, preparation of spray solution and spraying in the field, apiculture, preparation and use of Bordeaux mixture / Bordeaux paste, production technology of BGA, Azolla, etc. bio-fertilizers, mushroom production technology, Knowledge and utilization of apps in seeking information about plant protection measures

#### **Soil Improvement Interventions (SS&AC & CRP) – 6 days**

Plot wise soil study, Crop Yield, manures and fertilizers used and soil testing report recommendations based on soil report , Soil Profile study, diagnosis of deficiency/toxicity symptoms of different nutrients and their management. **Demonstrations in** collection of soil samples, preferably using Geo Positioning System (GPS), preparation of compost / FYM, vermi-compost, green manuring , application of macro / micro-nutrients by observing symptoms on crops, application of fertilizers to fruit crops, recycling of organic matter application of plant growth regulators and judging suitability of water for irrigation.

#### **Fruit, Vegetable and Flower Production Interventions: (HOR) – 6 days**

Documentation of daily operations of major horticultural crops, Documentation of Indigenous Technical Knowledge (ITK) practices followed in cultivation of major horticultural crops in the village. Conducting demonstrations on budding and grafting, pruning, layout of orchards, maintenance and aftercare of major horticultural crops, rejuvenation of old orchards, Knowledge and utilization of apps in seeking information about production technology of horticultural crops, demonstration on seed bed preparation & nursery management.

#### **Food Processing and Storage Interventions: (HOR/ AEG) – 5 days**

Study of agro processing industry in village and vicinity and agro processing and preservation undertaken by host farmer for domestic consumption, documentation of

Indigenous Technical Knowledge (ITK) practices followed in food processing, preservation and storage in the village. Demonstrations in Zero Energy Cool Chamber, preparation of value added products of fruits, vegetables and flowers, preparation of milk products, packaging and adulterations.

**Animal Production Interventions: (AMP) – 5 days**

Documentation of daily, monthly maintenance and management of animals, documentation of Indigenous Technical Knowledge (ITK) practices followed in care and management of livestock in the village. Demonstrations viz. cleaning and disinfection of cattle shed / animal shelter, clean milk production, Organization of animal vaccination campaign in the village, preparation of low cost livestock feed / ration, fodder treatment, preparation of silage, improved management practices, poultry related demonstrations, backyard poultry, mobile apps, inland fishery.

**Extension and Transfer of Technology: (AEX) – 6 days**

Survey on utilization of internet and Mobile applications by the Farmers for agricultural purpose, Organization of group discussion on important need of villagers, need based training class, organization of farmers rally and agricultural exhibition, preparation of content for social and digital media, documentation of ITKs and success stories, visiting rural institutions & FPOs.

**Agricultural Economics and Farm Management Interventions: (AEC) – 6 days**

Techno-socio economic survey of host farmer, record of daily operations (plot wise / crop wise) carried (including land development) and calculating cost of cultivation/production, cost of cultivation for all crops, Consolidated annual expenditure and receipt statement from animal enterprises. Preparation of bank proposal for host farmer, study of existing crop plan and preparation of alternative crop plan, study of partial and complete budget of host farmer, study on utilization of market intelligence by host farmer, knowledge and utilization of apps in marketing of farm produce / processed products.



### Preparation of report and Evaluation – 7 days

The students will be evaluated by evaluation committee immediately in the tenth week on the basis of the report submitted, viva-voce and activities learnt in village attachment.

**Evaluation Pattern :** The following is the mark distribution and evaluation pattern for village stay component

S.No.	Component	Evaluation	Max.Marks
1	Orientation and survey of village	Agri. Extension	20
2	Agronomical interventions including seed production	Agronomy/Plant Breeding / Seed Tech	20
3	Plant protection interventions	Entomology/Pathology / Nematology / Agri. Microbiology	20
4	improvement interventions (Soil sampling and testing)	Soil Science / Crop Physiology	20
5	Fruit, Vegetable and flower production interventions	Horticulture	20
6	Food processing and storage inventions	Horticulture & Agri. Engineering	20
7	Animal production interventions	Animal Husbandry	20
8	Extension and transfer of technology activities	Agri. Extension	20
9	Economics and farm management interventions	Agri. Economics	20
10	Report preparation & Presentation	Evaluation Committee	20
<b>Total Marks</b>			<b>200</b>

#### **Note**

- S.No. 1 to 9 will be evaluated by the respective **Subject Matter Specialist**
- S.No 10 will be evaluated by the **evaluation committee**

#### **Evaluation Committee:**

The evaluation committee comprises of the following members.

1. Programme Officer
2. Programme Co-ordinator
3. Chairman (or) his nominee

## II. Unit Attachment (0+4) 80 marks - 24 days

The student would be visiting the research, educational, extension, NGO units engaged in the field of agriculture and rural development. They will get acquainted with the new technologies in the fields related with agriculture and allied subjects. They will also study the functioning of such unit and prepare a study report. The duration for unit attachment is four weeks. The students will also arrange a field visit of farmers in villages to such units. The students will be exposed to learn the organizational set up and pattern of the unit. The students will actually get engaged in understanding and implementing the on-going programme in various units.

### Plan of Unit attachment:

Sl.No.	Activity	No. of days
1	KVK attachment	6
2	Research Station attachment	6
3	NGO attachment	6
4	ATMA/State Agrl. Department	6
	<b>Total</b>	<b>24</b>

**Evaluation pattern for Unit attachment:** The following is the evaluation pattern for unit attachment.

Sl.No.	Items	Max.Marks
1.	Regularity and Attendance	10
2.	Work Performance and Discipline	10
3.	Final Report - KVK	10
4.	Final Report - Research Station	10
5.	Final Report – NGO	10
6.	Final Report – ATMA/State Agrl.Dept.	10
7.	Presentation of report	20
<b>Total Marks</b>		<b>80</b>

### Evaluation Committee:

The evaluation committee for this component comprises of the following members.

1. Programme Officer
2. Programme Coordinator
3. Chairman (or) his nominee

### III. Plant Clinic Attachment - 40 marks - 7 days (ENT, PAT, ANM & CRP)

Plant health is the most important aspect which is affected by a large magnitude of living and non-living factors. Plants may be adversely affected by biotic and abiotic factors which requires careful observations to come on any conclusion. Thus, in order to enable the student to diagnose the constraints accurately and to increase the on-farm problem solving ability in real life situation for initiation of right action at right time, the students would be engaged in plant clinic activities. Plant clinic activities would be conducted in co-ordination with concern unit where the student is attached for unit attachment under the guidance of Subject matter specialists. The students will undergo practically the various aspects of plant diagnostics, crop loss assessment, survey and surveillance of pest, diseases, weeds and deficiency symptoms. Plant Clinic activities includes preparation of plant disease album, damage symptoms, Diagnosis of damage made by different pests and pathogens. Diagnosis of deficiency / toxicity symptoms and management.

**Evaluation pattern for Plant Clinic Attachment:** The following is the evaluation pattern for Plant Clinic attachment.

S.No	Criteria	Max.Marks
1.	Diagnosis of Diseases, pests and deficiency	10
2.	Crop loss assessment	5
3.	Survey and surveillance	5
4.	Spot Recommendation	5
5.	Album for Diseases, Weed and Deficiency and Insect Pest collection	5
6.	Report preparation and evaluation	10
<b>Total</b>		<b>40</b>

**The evaluation committee** for this component comprises of the following members.

1. Programme Officer
2. Subject Matter Specialist
3. Chairman (or) his nominee

#### **IV. Agro Industry Attachment & Project Report Preparation, Final Presentation and Evaluation of AIA - 80 Marks - 24 days**

Agro-industrial attachment and training of short duration in relevant industry is useful to gain the knowledge and experience of the work culture. This will expose the students to the industrial environment enhancing skill and help in developing job creating culture. Thus, the students shall be placed in Agro and Cottage industries and Commodities Boards for 3 weeks. The students will be assigned following activities and tasks during their agro-industrial attachments. One week allocated for project report preparation, final presentation and Evaluation.

##### **Activities and Tasks during Agro-Industrial Attachment Programme**

- Acquaintance with industry and staff
- Study of structure, functioning, objective and mandates of the industry
- Study of various processing units and hands-on trainings under supervision of industry staff
- Ethics of industry
- Employment generated by the industry
- Contribution of the industry promoting environment
- Learning business network including outlets of the industry
- Skill development in all crucial tasks of the industry
- Documentation of the activities and task performed by the students

##### **The evaluation pattern of Agro-Industrial Attachment:**

<b>S.No</b>	<b>Criteria</b>	<b>Max.Marks</b>
1.	Initiative and compliance	5
2.	General conduct and discipline	5
3.	Project planning and implementation	15
4.	Work Performance	15
5.	Report preparation	20
6.	Presentation & Viva-voce	10
7.	Innovative ideas/project in respect of entrepreneurship development	10
<b>Total</b>		<b>80</b>

The **evaluation committee** for this component comprises of the following members.

1. Programme Officer
2. Subject Matter Specialist –AIA Placement
3. Chairman (or) his nominee

#### **Functional Components of RAWE & AIA:**

The following are the staff involved in this programme and their responsibilities:

**1. Chairman :** Dean or his nominee will be the Chairman of the RAE 401

- a. Monitor and supervise the programme
- b. Nominate the officials for the programme
- c. Chairman for evaluation committee

**2. Programme Co-ordinator for RAE 401:** The Programme Coordinator for the RAE 401 course is from the Agricultural Extension discipline.

#### **Duties and Responsibilities**

- a. Planning the RAE 401 course
- b. General orientation & On campus training by different faculties.
- c. Organizing the Village, Unit attachments, Plant clinic and Agro-Industrial attachments
- d. Preparation of interview schedules for village study, farmer study, NGO study, etc.
- e. Consolidation of marks
- f. Act as SMS for Extension component
- g. Disbursing stipend to students if any

**3. Programme Officers:** One programme officer for each 30 students will be nominated by the Dean. They are the key officials in the implementation of RAE 401 course at village level. They will be serving in cluster containing 3 villages. The Programme Officer shall work in consultation with Programme coordinator.

### **Duties and Responsibilities**

- a. Forming 3 batches comprising 10 students per batch
- b. Identification of stay location for each batch and arranging for their stay in the respective stay location.
- c. Identification of a common place (KVK/Research Stations/BAECs etc.) for coordinating all the activities such as meeting with students, evaluation etc.
- d. Identifying study villages and host farmers.
- e. Arranging NGO attachment for their respective cluster in the nearby areas of the stay locations.
- f. Identifying agro-industries and place the students in industries.
- g. Monitoring the field level activities of the students, providing technical guidance and counseling.

**4. Subject Matter Specialists:** A group of scientists will act as subject matter specialist who will guide the students for their activities. They will also evaluate the students in their respective subjects. The SMS team comprises the scientists from Agronomy, Agricultural Economics, Agricultural Entomology, Horticulture, Plant Breeding and Genetics, Plant Pathology, Soil Science and Agricultural Chemistry, Animal Husbandry, Agrl. Extension, Crop Physiology, Nematology, Agrl. Microbiology, Seed Science & Technology and Agricultural Engineering.

SMS for Agro Industrial Attachment will be from discipline of Agricultural Economics.

### **Consolidated Mark sheet for RAE 401 course**

Reg.No	Name of Student	Village Placement (200)	Unit attachment (80)	Plant Clinic (40)	AIA (80)	Total marks for 400

Programme Coordinator

/

Chairman

Mark scored by student out of 400 marks will be converted to marks scored out of 100 marks and sent to University.

S.No	Reg.No	Name of Student	Marks out of 100

## **PJN 401 Educational Tour-II (All India)**

### **Syllabus**

- ② Visit to important National and International institutes related to agriculture, horticulture, forestry and allied fields in various regions of the country. Exposure to varied agro-climatic zones, crops grown, cultivation practices, socio-economic and cultural features of the farming community in different parts of the country.

## SEMESTER VIII

Course No.	Course Title	Credit Hours
ELP XXX	Experiential Learning Programme -1	0+10
ELP XXX	Experiential Learning Programme -2	0+10
	<b>Total</b>	<b>0+20=20</b>

### EXPERIENTIAL LEARNING 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 405	Organic Production Technology	0+10	VIII
6.	ELP 406	Integrated Farming System	0+10	VIII
7.	ELP 407	Poultry Production Technology	0+10	VIII
8.	ELP 408	Commercial Horticulture	0+10	VIII
9.	ELP 409	Floriculture & Landscape Architecture	0+10	VIII
10.	ELP 410	Molecular Breeding	0+10	VIII
11.	ELP 411	Plant Tissue Culture	0+10	VIII
12.	ELP 412	Commercial Seed Production	0+10	VIII
13.	ELP 413	Mushroom Cultivation Technology	0+10	VIII
14.	ELP 414	Bio-inoculants Production Technology	0+10	VIII
15.	ELP 415	Soil, Plant, Water, Manure and Fertilizers Testing	0+10	VIII
16.	ELP 416	Agriculture Waste Management	0+10	VIII



The following is the evaluation pattern and committee for the ELP modules

S.No.	Criteria	Max.Marks
1.	Project Planning and Writing	10
2.	Presentation (pertaining to the product preparation, exhibits, cleanliness)	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 and viva	10
Total Marks		100

The following is the evaluation committee for ELP Courses

1. Course teacher
2. External Examiner (nominated by the Dean)
3. Head of the concerned department

## ELP 401 COMMERCIAL BEE KEEPING (0+10)

### Outcome:

- Skill in commercial bee keeping

### 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)

### Outcome:

- Skill in Commercial Sericulture

### 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. Pruning 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)

### Outcome:

- Skill in Urban Entomology and Commercial Pest Control Management

### PRACTICAL SCHEDULE

1. Mosquitoes: species identification in larval and 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)**  
(Team teaching by Entomologists, Pathologists and Economists)

**Outcome:**

- Skill in commercial production of Bio-control agents

**PRACTICAL SCHEDULE - AGRICULTURAL ENTOMOLOGY**

1. Rearing of host insect –*Corcyra cephalonica*
2. Rearing of host insect- *Helicoverpa armigera* and *Spodoptera litura*
3. Rearing of predators-*Chrysoperla carnea* and *Cryptolaemus montrouzei*
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

**PRACTICAL – PLANT 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

### 1<sup>st</sup> 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

### 2<sup>nd</sup> 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*

### 3<sup>rd</sup> 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

### 4<sup>th</sup> 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

### 5<sup>th</sup> 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

### 6<sup>th</sup> 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

### 7<sup>th</sup> 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

### 8<sup>th</sup> 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 405 Organic Production Technology (0+10)**

### **Outcome:**

- Skill in Organic Production Technology

### **Objective**

To enable students to gain hands-on-experience in Organic production technologies and to train the students in establishing an Organic Farming unit.

### **Activities**

- Suitability, identification and development of Organic farming field
- Preparation of Organic farm maps with boundaries.
- Estimation of soil fertility, resources availability both on and off farm with their potential
- Maintenance of records and registers for an organic farm
- Planning of a suitable Integrated farming system model for a diversified ecosystem
- Preparation of wastes and other recycling methods
- Preparation of biological (nutrient / pest control) solutions
- Preparation of cropping system and resource budgeting
- Carrying out Certification procedures.
- Establishing organic outlet and proceeds for sale.
- Working out Production, Environmental and economic sustainability indices
- Preparation of DPR for bankable project

### **Deliverables**

The student who completes this course will be able to establish an organic farm individually and be able to know the procedures for certification and commercialization.

### **References**

1. Nicholas Lampkin 1994. Organic farming. Farming press London.
2. Arunkumar Sharma 2008. A Hand book of organic farming. Agrobios Publishers.
3. Dahama, A.K. 2009. Organic farming for sustainable agriculture, Agrobros publishers.
4. Veeresh, G.K. 2010. Organic farming, Cambridge university press.
5. SP. Palaniappan and K Annadurai. 2008. Organic Farming: Theory and Practice. 2008. Scientific Publishers.
6. Stockdale, E *et al.*, 2000. Agronomic and environmental implications of organic farming systems. *Advances in Agronomy*, 70, 261-327



**Outcome:**

- Hands–on-experience in commercial Integrated Farming System
- Skill in establishing a commercial IFS unit.

**Objective**

To enable students to gain hands–on-experience in commercial Integrated Farming System and to train the students in establishing a commercial IFS unit.

**Activities**

Farming systems models- Definition - Principles - Concepts - Enterprises selection and management - interaction between different enterprises– scope and advantages of Integrated Farming system –Study of models of Integrated Farming System-Wetland- Garden land-Dryland-Variou components of IFS- related enterprise. Visit to different units: dairy, goat, poultry, fishery. Mushroom, sericulture and biogas - study on evaluation indicators on farming system - on farm field visit.

**Deliverables**

The student who completes this course will be able to establish and run integrated farm with various enterprises.

**References**

1. Jayanthi, C. Devasenapathy, P and C. Vennila. 2007. Farming Systems. Principles and practices. Satish Serial Publishing House.Delhi.
2. Jayanthi, C., N. Sakthivel, N. Sankaran and T.M. Thiyagarajan. 2003. Integrated Farming system – A Path to Sustainable Agriculture. TNAU Publication.
3. S.C. Panda. 2003. Cropping and Farming Systems. Agrobios Publishers. Jodhpur.
4. Palaniappan, SP and K. Sivaraman.1996. Cropping systems in the tropics Principles and management. New Age International (P) Ltd., New Delhi.

## **ELP 407 POULTRY PRODUCTION TECHNOLOGY (0+10)**

### **Outcome:**

- Skill in Commercial Poultry Production Technology

### **Objective:**

To develop students as entrepreneurs and managers by providing hands on experience in all the aspects of poultry farming.

### **Activities:**

Current status and scope of poultry production in India - Commercial strains of poultry.- Housing management – Location and layout of commercial poultry farm– Preparation of poultry house - Equipments used in poultry farms - Different systems of Management - Deep litter, cage and raised housing - Litter management - Preparation of brooder house – Brooder Management – Chick management – Grower management – Layer management – Broiler management - Summer and Winter management - Common procedures followed in poultry farms - Feeding – Feeding Management of poultry – Types of feed – Feed ingredients – Quality assessment of feed ingredients and feed – Feed additives - Nutrient requirement of different stages of broilers and layers – Feed formulations – Hatchery Management – Egg and chick quality assessment - Flock Health Management - Common disease of poultry – Control and Prevention – Medication and Vaccination – Postmortem inspection – Waste management - Disposal of dead birds and Manure management - Biosecurity measures - Processing and Marketing - Record maintenance - Marketing - Integration - poultry farm economics - Visit to commercial poultry farms, feed plant, hatchery unit and processing plant.

### **References :**

1. ICAR, 2015. A Hand Book of Animal Husbandry
2. Gopalakrishnan, C.A., and Lal, D.M.M., 1992. Livestock and Poultry Enterprises for Rural Development. Vikas Publications Private Limited, Ghazhiabad, Uttar Pradesh.
3. Banerjee, G.C. 2011. A Text Book of Animal Husbandry. Oxford Company New Delhi...
4. Kadirvel, R., and Balakrishnan, V., 1998. Hand Book of Poultry Nutrition. Madras Veterinary College, TANUVAS., Chennai.
5. Prabakaran, R., 1998. Commercial Chicken Production. Publisher P.Saranya, 5/2, Ramalingam Street, Seven Wells, Chennai
6. Asha Rajini, 2011. R. Simply Poultry Science, Alpha Publications, NewDelhi.,

**Outcome:**

- Skill in Production of plantlets, production of potted plants, management and maintenance, sale and marketing.
- Skill in Nursery raising/procurement and transplanting, management and maintenance of the crop, postharvest handling, quality control and marketing.

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**

**Outcomes:**

- Skill in Commercial Floriculture
- Skill in Making of lawns, use of software in landscape.
- Skill in Making of bouquets, button hole, wreath, veni and gazaras, car and marriage palaces.

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).

**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**

## References

1. Alex Laurie and Victor H.Ries, 2004. Floriculture Fundamentals and Practices, Agrobios, India
2. Auto CAD. 2004. A problem solving approach, Tickoo, ISBN 1-4018-51339
3. Bhattacharjee, S.K., 2004. Landscape gardening and design-with plants. Aav'ishkar Publishers and Distributors, Jaipur, India.
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.
9. Paul Lesniewicz., 1994. Bonsai in your home. Sterling publishing Co, New York
10. Peter McHoy. 1997. The A-Z guide to house plants, Marshall- cavendish publishers, Italy
11. Randhawa, G.S. and A. Mukhopadyay. 1998. Floriculture in India. Allied publishers Limited, New Delhi
12. Reader's Digest Success with House Plants, 1979. The Reader's Digest Assoaatien, Inc. Pleasantvilli, New York / Montreal.

## **ELP 410 MOLECULAR BREEDING (0+10)**

### **Outcome:**

- knowledge and hands-on-experience in use of molecular marker techniques in plant breeding and establish a marker lab.

### **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 crops Electrophoresis. PCR based marker assays. Genetic map construction using molecular markers Mapping 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:**

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2. Kurt Weising, Hilde Nybom, Kirsten Wolff and Gunter Kahl. 2005. DNA Fingerprinting in plants: Principles, methods and Applications, 2<sup>nd</sup> Edition, CRC Press, Taylor and Francis Group, Boca Raton, USA.

## **ELP 411 Plant Tissue Culture (0+10)**

### **Outcomes:**

- Skill in establishment of Plant Tissue Culture Laboratory, Medium and stock solution preparation.
- Skill in Meristem and Micropropagation in Banana and Neem, Micropropagation of Eucalyptus and Aloe vera

### **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 Accredited TC Testing Lab/National Certification Centre- NRCB, Trichy

#### **16. Project proposal preparation.**

Project proposal preparation.

#### **17. Practical Examination**

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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.
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4. George E.F., Hall, M.A. and De Klerk, G.J. 2008. **Plant Propagation by Tissue Culture. Volume 1. 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)

### Outcomes:

- Skill in Commercial Seed Production

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.

## Practical schedule

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**  
**(Team teaching by Pathologists and Economists)**

**(0+10)**

**Outcomes:**

- Skill in Mushroom Cultivation

**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**

**1<sup>st</sup> 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

## **2<sup>nd</sup> 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

## **3<sup>rd</sup> 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

## **4<sup>th</sup> 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

## **5<sup>th</sup> 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

## **6<sup>th</sup> 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 uzhar sandai (Farmers' Market), markets and observing the marketing pattern

## **7<sup>th</sup> 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

## **8<sup>th</sup> 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

**9<sup>th</sup> 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

**10<sup>th</sup> 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

**11<sup>th</sup> 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

**12<sup>th</sup> 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

**13<sup>th</sup> 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

**14<sup>th</sup> 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

**15<sup>th</sup> 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

**16<sup>th</sup> 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

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5. Pathak,V.N., Nagendra Yadav and Maneekas Gaur. 2000. Mushroom production and processing Technology. Agribios (India) Ltd., New Delhi

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4. [www.krishniworld.com/html/mushroom.html](http://www.krishniworld.com/html/mushroom.html)
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6. [www.mushworld.com/home/](http://www.mushworld.com/home/)

## ELP 414 Bio-inoculants Production Technology (0+10)

### Outcomes:

- Skill in Commercial Bio-inoculants

### 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 Methylootrophs (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

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## ELP 415 Soil, Plant, Water, Manure and Fertilizers Testing (0+10)

### Outcomes:

- Skill in testing of Plant, Water, Manure and Fertilizers

### Week 1:

Good laboratory practices (GLP), Do's and Dont's in a soil chemical laboratory and First aid in laboratory. **Principles of analytical chemistry:** Analytical techniques, concepts of gravimetry, concepts of titrimetry (volumetric), preparation of standard solution of an acid, standardization.

### Week 2:

**Instruments used in soil, plant, water, manure and fertilizer analysis:** Potentiometer (pH meter), Conductometer (EC bridge), Spectrophotometer, Flame photometer, Atomic Absorption, Spectrophotometer (AAS)

### Week 3:

**Soil Analysis:** Collection and preparation of soils samples, study of soil profile, **physical properties of soil:** mechanical analysis (soil texture), International pipette method, Hydrometer method, Determination of soil texture by feel method.

### Week 4:

**Density of soil:** Bulk density, Particle density and Pore space of soil. Soil colour, **physico chemical properties of soil:** pH, EC, Chemical properties of soil, organic matter in soil, cation exchange capacity (CEC) of soil, Determination of exchangeable Calcium, Magnesium, Sodium and Potassium in soil,

### Week 5:

**Major nutrients in soil:** Available Nitrogen, Phosphorus and Potassium in soil. **Secondary nutrients in soil:** available sulphur in soil, **Micronutrients in soil:** Available micronutrient (Fe, Cu, Mn and Zn) cations in soil, available boron in soil.

### Week 6:

**Problematic soils and amendments for acid soil:** Soil acidity and lime requirement, Determination of exchangeable acidity in soil, reserve acidity in soil, extractable aluminum in soil, lime requirement of acid on soil, Determination of lime content of soil.

### Week 7:

**Problematic soils and amendments for Sodic soil:** Soil alkalinity and gypsum requirement, carbonate and bicarbonate in soil, sodium in soil, gypsum requirement of alkali soil.

### **Week 8:**

**Irrigation Water Analysis:** Irrigation water sampling, Determination of pH, electrical conductivity, carbonate, bicarbonate, chloride, sulphate, calcium magnesium and sodium in irrigation water. Computation of SAR and RSC of irrigation water. Determination of boron in irrigation water.

### **Week 9:**

**Plant Analysis :** Sampling handling and preparation of plant sample, Determination of Nitrogen in plant sample, Digestion of plant sample for estimation of nutrients (except nitrogen).

### **Week 10:**

**Plant Analysis :** Determination of phosphorus, potassium, calcium, magnesium, sulfur and micronutrients in plant sample.

### **Week 11:**

**Organic Manure Analysis :** Determination of pH, EC, organic carbon, nitrogen. Digestion for estimation of other nutrients in manure. Determination of phosphorus, potassium, calcium, magnesium, sulfur and micronutrients in manure.

### **Week 12:**

**Fertilizer Analysis :** Fertilizer sampling, Qualitative test for identification of fertilizer, Detection of adulterants in fertilizer, Estimation of ammonium nitrogen ( $\text{NH}_4 - \text{N}$ ) in ammonium fertilizer, nitrate nitrogen ( $\text{NO}_3 - \text{N}$ ) in nitrate fertilizer,

### **Week 13:**

**Fertilizer Analysis :** amide nitrogen ( $\text{NH}_2 - \text{N}$ ) in amide fertilizer (urea), Determination of biuret content of urea, Estimation of phosphorus in phosphatic fertilizer, Determination of potassium in potassic fertilizer.

### **Week 14:**

**Fertilizer calculation and recommendation:** Fertilizer prescription calculations for important crops - Nutrient equivalent basis - Soil Test Crop Response based recommendation for targeted yields.

### **Week 15:**

**Fertilizer calculation and recommendation:** Deriving the nutrient requirement using DSSIFER software for different crops (STCR), and Fertilizer prescription using DSSIFER software

### **Week 16:**

Preparation of Soil Health Card, Preparation of project report.

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## **ELP 416 Agriculture Waste Management (0+10)**

### **Outcomes:**

- Skill in Management of Agriculture Waste

### **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<sub>2</sub> – (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 Cropping Systems. Lewis Publishers, Boca Raton, FL

10. Tandon, H.L.S. 1992. Fertilizers, Organic Manures, Recyclable Wastes and Biofertilizers. Fertilizer Development and Consultation Organization.
11. Tandon, H.L.S. 1993. Methods of Analysis of Soils, Plants, Waters and Fertilizers. Fertilizer Development and Consultation Organization. 143p.
12. Yawalkar, K.S., Agrawal, J.P. and Bokde, S. 1981. Manures and Fertilizers. Agri-

**E -References:**

1. <http://www.eartheasy.com>
2. <http://www.compostingcouncil.org>
3. <http://www.Epa.gov/compost>

### ELECTIVE COURSES

Course No.	Course Title	Cr. Hrs.	Semester
AEC 251	Agribusiness Management	2+1	IV
AEX 251	Agricultural Journalism	2+1	IV
AGR 251	Weed Management	2+1	IV
HOR 251	Landscaping	2+1	IV
AGR 351	System Simulation and Agro-advisory	2+1	V
GPB 351	Commercial Plant Breeding	2+1	V
HOR 351	Protected Cultivation	2+1	V
HOR 352	Hi-tech Horticulture	2+1	VI
GPB 352	Micro Propagation Technologies	2+1	VI
AGM352	Applied Microbiology	2+1	VI
SAC 352	Agrochemicals	2+1	VI



## **AEC 251 Agribusiness Management (2+1)**

### **Outcomes:**

- In-depth understanding the nature and scope of Agribusiness Management, Management functions, Human Resources, Finance and Marketing.
- Understanding the classification of agricultural projects, Types of agro-based industries, Laws and policies related to agri-business in India.

### **Theory**

#### **Unit I: Agribusiness and Management**

Agribusiness – Definition – Nature and Scope – Transformation of agriculture into agribusiness, various stakeholders and components of agribusiness systems. Structure of Agribusiness (input, farm and product sectors) - Agribusiness Management - Distinctive features of Agribusiness - Importance of Agribusiness in Indian Economy and New Agricultural Policy – Agri-value chain: Understanding primary and support activities and their linkages. Business environment – PEST and SWOT analysis.

Management – Definition and Importance – Management functions – Nature. Management - Skills, Levels and functional areas of management. Forms of Business Organisation – Sole Proprietorship – Partnership – Private and Public Limited - Cooperatives.

#### **Unit II: Management Functions**

Management functions: Roles and activities, organizational culture. Planning – Definition – Types of plans (Purpose or Mission, Goals or Objectives, Strategies, Policies, Procedures, Rules, Programmes, Budget). Steps in planning and implementation – Characteristics of Sound plan. Objectives – MBO. Organizing – Principles of Organizing – Concept of Departmentation-Delegation- Centralization – Decentralization.

Staffing – Concept – Human Resource Planning – Process. Directing – Concept – Principles – Techniques, Supervision. Motivation – Concept - **Maslow's Need Hierarchy Theory – Types – Techniques. Communication – Definition and Process – Models – Types – Barriers. Leadership – Definition – Styles – Difference between leadership and management. Controlling – Concept - Steps – Types – Importance – Process.**

#### **Unit III: Functional areas of management**

Functional areas: Operations, Human Resources, Finance and Marketing – Meaning and scope. Operations management: meaning – physical facilities – implementing the plan. Inventory control: meaning – inventory model – EOQ. Financial management of agribusiness: Financial statements and their importance – Balance sheet, Network analysis and Cash flow analysis. Marketing management: meaning, definition – market segmentation, targeting and positioning – 4Ps of marketing mix and marketing strategies. Consumer behavior analysis Product Life Cycle (PLC). Sales and distribution management. Pricing policy, various pricing methods.

#### **Unit IV: Preparation of bankable project**

Project management: Definition – classification of agricultural projects – Project cycle: Identification, Formulation, Appraisal, Implementation, Monitoring and Evaluation. Project appraisal and evaluation of bankable projects – Pay Back Period, BCR, NPW and IRR. Agro-based industries – importance and need – Types of agro-based industries – institutional arrangements. Procedure to set up agro-based industries, constraints in establishing agro-based industries- Laws and policies related to agri-business in India.

#### **Practical**

Study of agri-input markets: Seed, fertilisers, pesticides. Study of output markets: grains, fruits, vegetables, flowers. Study of product markets, retail trade commodity trading, and value added products. Study of financing institutions – Cooperative, Commercial banks, RRBs, Agribusiness Finance Limited, NABARD. Preparation of projects and Feasibility reports for agribusiness entrepreneur. Appraisal/evaluation techniques of identifying viable project – Non-discounting techniques. Case study of agro-based industries. Trend and growth rate of prices of agricultural commodities. Net present worth technique for selection of viable project. Internal rate of return.

#### **Theory schedule**

1. Agribusiness – Nature and scope – Transformation of agriculture into agribusiness, various stakeholders and components of agribusiness systems.
2. Agribusiness – definition - Structure of Agribusiness (input, farm and product sectors).
3. Agribusiness Management - Distinctive features of Agribusiness - Importance of Agribusiness in Indian Economy – New Agricultural Policy.
4. Agri-supply chain management and agri-value chain management – Forward and Backward linkages.
5. Business environment – analyzing the demographic, economic, socio-cultural, natural, technological and political-legal environment.
6. Business environment – PEST and SWOT analysis.
7. Management – Definition and Importance – Management functions. Management –Roles, Skills, Levels, Activities and organizational culture.
8. Forms of Business Organisation – Sole Proprietorship – Partnership –Private and Public Limited - Cooperatives.
9. Management functions: Planning – Definition – Types of plans (Purpose or Mission, Goals or Objectives, Strategies, Policies, Procedures, Rules, Programmes, Budget).
10. Steps in planning – Characteristics of Sound plan. Objectives – MBO
11. Organizing – Principles of Organizing – Organisation structure – Formal and Informal Organisation.
12. Concept of Departmentation- Span of control – Authority and Responsibility – Concept and Meaning. Delegation- Centralization – Decentralization
13. Staffing – Concept – Human Resource Planning – Process.
14. Directing – Concept – Principles – Techniques -ordering, leading, supervision.
15. Motivation – Concept - Maslow's Need Hierarchy Theory – Types – Techniques.
16. Communication – Definition and Process – Models – Types – Barriers.

17. Leadership – Definition – Styles – Difference between leadership and management.

**18. Mid-semester examination**

19. Controlling – Concept - Steps – Types – Importance – Process.

20. Functional areas of management: Operations management: meaning – operating system – physical facilities – implementing the plan.

21. Scheduling the work – controlling production in terms of quantity and quality – ISO standards – HACCP – TQM.

22. Inventory – meaning – types – inventory costs – inventory management – EOQ.

23. Financial management – financial statements – importance and need – Balance sheet, Networth analysis and cash flow analysis.

24. Marketing management: meaning, definition – market segmentation, targeting and positioning – 4Ps of marketing mix and marketing strategies.

25. Consumer buying behavior – factors influencing buying behavior – Buying decision process.

26. Sales and distribution management.

27. Pricing policy- pricing method – pricing at various stages of marketing.

28. Project – meaning, definition – classification of agricultural projects – project cycle – Identification, formulation, appraisal, implementation, monitoring and evaluation.

29. Project appraisal and evaluation techniques – undiscounted and discounted measures.

30. Agro-based industries – importance and need – types of agro-based industries – institutional arrangements for financing agro-based industries.

31. Procedure to set up agro-based industries – constraints in establishing agro-based industries.

32. Business plan – components of business plan.

33. Preparation of project reports for various activities in agriculture and allied sectors.

34. Laws and policies related to agri-business in India.

**Practical schedule**

1. Study of agro-input markets: Seeds, fertilizers and pesticides.

2. Visit to output markets – Regulated market/Uzhavarsandhai.

3. Visit to output markets – Shandies/flower market.

4. Visit to agro-processing unit to study retail trade, commodity trading and value addition.

5. Visit to Cooperatives to know their role in agriculture development.

6. Visit to Lead Bank/RRBs.

7. Visit to NABARD district office.

8. A case study of agro-based industries – preparation and presentation of project report.

9. Exercise on project evaluation techniques – Undiscounted measures.

10. Exercise on project evaluation techniques – Discounted measures.

11. Preparation of bankable project – I.

12. Preparation of bankable project – II.

13. Group presentation of projects – I.

14. Group presentation of projects – II.

15. Trend and growth rate in prices of agro-inputs.

16. Trend and growth rate in prices of agricultural commodities.

**17. Final Practical examination**

## References

1. Prasad, L.M, 2005, 'Principles and Practices of Management', Sultan Chand and Sons Educational Publishers, New Delhi.
2. Richard, B Chase, Nicholas J., Acquilano and F.Robert Jacobs, 2007, 'Production and Operations Management - Manufacturing and service, Tata McGraw Hill Publishing Company Limited, New Delhi.
3. Aswathappa, K, Human Resource Management: Text and Cases, Tata McGraw-Hill Pub. Co. Ltd. New Delhi, 5th Edition, 2008.
4. Philip Kotler and Kevin L.K, Marketing Management, Pearson India Education Services Pvt Ltd, 2016.
5. Chandra Prasanna. 2000. Financial Management - Theory and Practice. Tata McGraw Hill Publishing Company Ltd., New Delhi.
6. R.K.Sapru, Project Management, Excel Books, New Delhi, 1997.
7. Philip Kotler, Kevin L.K, Swee H.A, Chin T.T, Siew M.L, Marketing Management: An Asian Perspective, Pearson Education Ltd, UK, 2018.
8. Gittinger,J.P., Economic analysis of agricultural projects. The John Hopkins University Press, Baltimore, USA, 1982.

## E-References

1. [www. management teacher.com](http://www.managementteacher.com)
2. [www.management.about.com](http://www.management.about.com)
3. [www.bized.co.uk](http://www.bized.co.uk)
4. [http:// managementhelp.org/](http://managementhelp.org/)
5. [www.fma.org](http://www.fma.org)
6. <http://www.ifmr.ac.in>

## **AEX 251 Agricultural Journalism (2+1)**

### **Outcomes:**

- In-depth understanding the nature and scope of agricultural journalism, components of newspapers and magazines and collection of other agricultural news sources.
- Understanding how to write the agricultural stories, reporting using of photographs, artworks, graphs, charts, maps & editing and publishing.

### **Theory**

#### **Unit I: Introduction to Agricultural Journalism**

Agricultural Journalism: The nature and scope of agricultural journalism characteristics and how agricultural journalism is similar to and different from other types of journalism, ethics of journalism.

#### **Unit II: Components of News paper and Magazines**

Newspapers and magazines as communication media: Characteristics; kinds and functions of newspapers and magazines, characteristics of newspaper and magazine readers. Form and content of newspapers and magazines: Style and language of newspapers and magazines, parts of newspapers and magazines.

#### **Unit III: Collection of Information**

The agricultural story: Types of agricultural stories, subject matter of the agricultural story, structure of the agricultural story. Gathering agricultural information: Sources of agricultural information, interviews, coverage of events, abstracting from research and scientific materials, wire services, other agricultural news sources.

#### **Unit IV: Reporting and Writing Agricultural Stories**

Writing the story: Organizing the material, treatment of the story, writing the news lead and the body, readability measures. Illustrating agricultural stories: Use of photographs, use of artwork (graphs, charts, maps, etc.), writing the captions.

#### **Unit V: Editing and Publishing**

Editorial mechanics: Copy reading, headline and title writing, proofreading, lay outing, E-Journalism

### **Theory Schedule :**

1. Journalism – Meaning, Definition, Principles
2. Origin and Types of journalism
3. Agricultural Journalism the nature and scope of agricultural journalism, characteristics
4. Similarities and differences between agricultural journalism and other types of journalism
5. Ethics of journalism
6. Characteristics of newspapers and magazines
7. Kinds and functions of newspapers and magazines
8. Types of News

9. Characteristics of newspaper and magazine readers.
10. Parts of newspapers and magazines.
11. Style and language of newspapers
12. Style and language of magazines,
13. Balancing news paper and symmetry
14. The agricultural story: Types of agricultural stories
15. Subject matter of the agricultural story, structure of the agricultural story
16. Gathering agricultural information: Sources of agricultural information
17. MID SEMESTER
18. Interviews, types and coverage of events
19. Abstracting from research and scientific materials, wire services, other agricultural news sources
20. Writing feature stories, structure
21. Writing the story: Organizing the material
22. Treatment of the story, writing the news lead and the body
23. Readability measures
24. Photo journalism
25. Newspaper design concepts
26. Writing news stories and inverted pyramid
27. Elements of news / qualities of news
28. Reporting - qualities of a good reporter, reporting skills
29. Editing - general principles of editing, qualities of an editor
30. Headline and title writing, proof reading, lay outing.
31. Editorial mechanics: Copy reading
32. E- Journalism - online journalism , scope and Importance in agricultural journalism.

### **Practical**

Practice in interviewing. Covering agricultural events. Abstracting stories from research and scientific materials and from wire services. Writing different types of agricultural stories. Selecting pictures and artwork for the agricultural story. Practice in editing, copy reading, headline and title writing, proofreading, layouting. Testing copy with a readability formula. Visit to a publishing office.

### **Practical Schedule**

1. Practice in interviewing
2. Visit to village and interview farmers / farm women
3. Interview with agricultural officers
4. Practice in abstracting stories from research and scientific materials
5. Visit to a publishing office
6. Writing news stories
7. Writing feature stories
8. Practice in editing, copy reading, headline and title writing
9. Understanding about designing and layouting
10. Preparing layout of farm publication

11. Preparing cover design of farm publication
12. Testing copy with a readability formula
13. Practice in photography and editing –I
14. Practice in photography and editing –II
15. Practice in videography and editing-I
16. Practice in videography and editing-II
17. Practical Exam

### **References:**

1. Arvind Kumar (1999). The Electronic Media. Anmol Publications, New Delhi.
2. Bhatt, S.C. (1993) Broadcast Journalism. Basic Principles Har Anand Publications, Delhi
3. Bhatnagar, R. (2001). Print Media and Broadcast Journalism. Indian Publisher Distributors, Delhi
4. Katyal, V.P (2007). Fundamentals of Media Ethics. Cyber Tech Publishers, New Delhi.
5. Yadava, J.S and Mathur, P. (1998). Issues in Mass Communication: the basic concepts. Volumes 1 and 2. Indian Institute of Mass Communication, New Delhi.

## **AGR 251      WEED MANAGEMENT      (2+1)**

### **Outcomes:**

- In-depth understanding the characteristics of weeds, biology, ecology, methods, physical, chemical, biological, Integrated weed management and use in herbicides.
- Understanding the mode of action of herbicides, behavior of herbicides in soil, allelopathy and its application, problematic weeds and their control.

### **Theory:**

#### **Unit I: Introduction to Weeds**

Introduction to weeds – Definition and classification; characteristics of weeds, their harmful and beneficial effects on ecosystem, reproduction and dissemination of weeds. Weed biology and ecology, crop weed competition and allelopathy.

#### **Unit II: Methods of weed control**

Principles 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. Concept of adjuvant, surfactant, herbicide formulation and their use, methods of application. Herbicide antidotes and their use in herbicides.

#### **Unit IV: Selectivity and activity of herbicides**

Introduction to mode of action of herbicides and selectivity. Herbicide absorption and translocation; Mode and mechanisms of action of herbicides. Concept of herbicide mixture and utility in agriculture. Herbicide compatibility with agro-chemicals and their application. Herbicide Resistance and its management; Herbicide resistant crops. Persistence and behavior of herbicides in soil

#### **Unit V: Weed management**

Allelopathy and its application for weed management. Bio-herbicides and their application in agriculture. Integration of herbicides with non chemical methods of weed management. Weed management in major field and horticultural crops, shift of weed flora in cropping systems, aquatic and problematic weeds and their control.

##### **Practical:**

Techniques of weed preservation. Weed identification and their losses study. Biology of important weeds - nut sedge, bermuda grass parthenium and *Echinochloa*. Weed control efficiency and weed index. Study of herbicide formulations and mixture of herbicide. Herbicide and agro-chemicals study. Study of methods of herbicide application, spraying equipments and calibration; Demonstration of methods of herbicide application; Shift of weed flora study in long term experiments. Calculations of herbicide doses. Visits of problem areas

##### **Lecture schedule:**

1. Weeds-Definition and classification – based on relative position, origin, morphology and life cycle
2. Classification of weeds – based on growth characteristics, habitat, ecological affinity to water and dependence on other plants
3. Characteristics of weeds - harmful and beneficial effects of weeds
4. Weed biology and ecology- Life cycle of weeds, Weed reproduction, weed dissemination,
5. Weed seed germination; Weed dormancy; Weed Ecology
6. Crop weed association- crop weed competition; Critical period of crop weed competition. Competitive and allelopathic effects of weeds and crops.
7. Principles of weed management- Prevention, eradication and control.
8. Methods of weed management - Physical/Mechanical
9. Methods of weed management - Cultural
10. Methods of weed management - biological.
11. Methods of weed management – chemical; Herbicides - advantages and limitations of herbicide usage.
12. Herbicide classification.
13. Herbicide formulations and methods of application.
14. Commonly used herbicides in India
15. Introduction to adjuvants and surfactants - herbicide antidotes and their use in herbicides.



16. Activity and selectivity of herbicides; Factors affecting activity and selectivity.

**17. MID-SEMESTER EXAMINATION**

18. Herbicide absorption and translocation; Factors influencing herbicide absorption and translocation.

19. Mode of action of herbicides

20. Mechanism of action of herbicides and their selectivity.

21. Herbicide mixtures, rotations and interactions with other agro chemicals.

22. Persistence and behavior of herbicides in soil

23. Residual effect of herbicides and herbicide residue management

24. Definitions of Herbicide resistance and management of herbicide resistance in weeds; Herbicide Resistant Crops

25. Allelopathy and its application for weed management.

26. Bio-herbicides and their application in agriculture.

27. Integration of herbicides with non chemical methods of weed management.

28. Weed management in major field crops

29. Weed management in major horticultural crops

30. Management of weeds in non-cropped situations

31. Management of aquatic and problematic weeds.

32. 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. Study of herbicide formulations and mixtures of herbicide.
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. Shift of weed flora study in long term experiments
16. Visit to Problem and parasitic weed infestation areas/ herbicide industries

**17. FINAL PRACTICAL EXAMINATION**

**References:**

1. Das, T.K. 2011. Weed Science: Basics and Applications, Jain Brothers, New Delhi
2. Gupta, O. P. 1998. Modern Weed Management. Agro Botanica Bikaner, India.
3. Hance, R.J. and K. Holly. 1990. Weed Control Handbook: Principles. Blackwell Scientific Publications, Oxford, London

4. Jaganathan R. and R.Jayakumar. 2003. Weed Science Principles, Kalyani Publishers, New Delhi.
5. Rao, V. S. 1983. Principles of Weed Science. Oxford and IBH Publishing Co. New Delhi.
6. Subramanian, S. A. Mohammed Ali and R. Jayakumar. 1991. All about Weed Control. Kalyani Publishers, New Delhi.

**HOR 251**

**LANDSCAPING**

**(2+1)**

Outcomes:

- In-depth understanding the importance and scope of landscaping, terrace and vertical gardening, trees selection and climber and creepers.
- Understanding the pot plant, bio-aesthetic planning, lawn: establishment and maintenance. CAD applications.

## **Theory**

### **UNIT I**

Importance and scope of landscaping. Principles of landscaping, garden styles and types, terrace gardening, vertical gardening, garden components, adornments, lawn making, rockery, water garden, walk-paths, bridges, other constructed features etc. gardens for special purposes.

### **UNIT II**

Trees: selection, propagation, planting schemes, canopy management, shrubs and herbaceous perennials: selection, propagation, planting schemes, architecture. Climber and creepers: importance, selection, propagation, planting,

### **UNIT III**

Annuals: selection, propagation, planting scheme, Other garden plants: palms, ferns, grasses and cacti succulents. Pot plants: selection, arrangement, management.

### **UNIT IV**

Bio-aesthetic planning: definition, need, planning; landscaping of urban and rural areas, Peri-urban landscaping, Landscaping of schools, public places like bus station, railway station, townships, river banks, hospitals, play grounds, airports, industries, institutions.

### **UNIT V**

Bonsai: principles and management, lawn: establishment and maintenance. CAD applications.

### **Practical**

Identification of trees, shrubs, annuals, pot plants; Propagation of trees, shrubs and annuals, care and maintenance of plants, potting and repotting, identification of tools and implements used in landscape design, training and pruning of plants for special effects, lawn establishment and maintenance, layout of formal gardens, informal gardens, special type of gardens (sunken garden, terrace garden, rock garden) and designing of conservatory and lath house. Use of computer software, visit to important gardens/ parks/ institutes.

## Theory

1. Importance and scope of landscaping- Goals of landscaping – Categories of landscaping (Residential, public, commercial, specialty landscaping).
2. Principles of landscaping-Initial approach – Axis – Focal Point – Mass effect – Unity – Space – Divisional Lines – Proportion and Scale – Texture – Time and Light – Tone and Colour – Mobility – Rhythm – Balance – Contract – Harmony – Vista – Style.
3. Garden types- Formal - Informal – Wild Garden - Styles of garden in the world- Mughal Garden- Site and design – Walls and gates – Terrace- Running water- Baradari- Trees and flowers.
4. Features of English – Italian – French – Persian Gardens – Japanese Garden – Types of Japanese Garden – Hill – Flat – Tea – Passage – Sand Gardens.
5. Features of Japanese Garden – Ponds – Streams – Waterfalls – Fountains – Islands – Bridges – Water Basins – Stone Lanterns – Stones – Pagodas – Fences and Gates – Vegetation (Ever green, Deciduous and Flowering plants).
6. Famous Gardens of India –Lal bagh (Bangalore) – Brindavan Garden (Mysore) – Government Botanic Gardens (Ootacamud) Mughal garden (Pinjore) – Chandigarh Rose garden.
7. Terrace gardening – Features –Plants suitable – Planning – Maintenance.
8. Vertical gardening – Components.
9. Garden components or features-Garden walls – Retaining wall – Fences and Gates – Hedges and Edges – Flower bed – Borders – Carpet Bedding - Steps – Garden Drives (Gravel and Asphalt) and Paths (Gravel, Brick, Grass, Stone, Crazy pavings).
10. Arches and Pergolas – Screens – Bridges – Outdoor garden rooms (Gazebos, garden pavilions, band stand, bower and thatched huts) walk-Paths, bridges, other constructed features etc.
11. Garden adornments– Garden Seats – Ornamental tubs, urns and vases – Bird baths – Sun dials – Floral Clocks – Japanese Lanterns – Ornamental Stones – Fountains – Statues – Towers – Wells – Plants Containers – Plant Strands.
12. Lawn making– Selection of Grass – Bermuda grass – Korean grass – Poa grass – Fescue grass – Kentucky blue grass - Grasses for shady areas – Site Selection – Soil – Preparation of soil – Drainage – Digging – Manuring and grading – Methods of planting – Sowing of Seeds – Dibbling.
13. Turfing – Turf plastering – Bricking – Planting on Polythene – Maintenance of lawn – Mowing – Rolling – Sweeping – Scraping – Raking – Weeding – Irrigation – Top dressing with compost and fertilizers - Diseases and other problems – Fairy ring – Pale Yellow Lawns.
14. Rockery- Rock Garden – Types of rock garden – Selection of site – Construction of the Rockery – Planting – Management of the Rockery – Plants for rock garden – Examples of cacti and succulents, ferns, shrubs, herbaceous plants, bulbs, flowering annuals.
15. Water garden – Informal pool – Formal Pool – Construction – Planting methods – Filling the pool (water course and falls) – Care of the water garden – Plants for water garden – Surface flowering aquatics – Oxygenators – Floaters – Marginals.
16. Gardens for special purposes- Specialized gardens – Herb garden – Bog Garden – Sunken garden – Topiary Garden – Kitchen garden – Paved garden – Moon Garden – Gardening in hanging baskets – Window garden – Miniature garden – Mini Zoo – Importance of Green house – Conservatory – Lath house – Fernery in ornamental horticulture.

## 17. Mid semester examination

18. Trees: Selection, propagation, planting schemes, canopy management- Ornamental and shady Trees – Definition – Classification based on purpose with suitable examples – Specimen trees – Shady trees – Flowering trees – Avenue or road side trees – Screening trees – Fragrant flowering trees – Pollution controlling trees .

19. Shrubs - Definition – Utility (aesthetic values) – Classification with suitable examples – Based on purpose of growing – Flowering – Foliage – Flowering and foliage – Fragrant shrubs – Based on sunlight requirement - Growing of shrubs – Soil – Climate – Cultivation practices.

20. Herbaceous perennials – Definition – Introduction – Classification with suitable examples – Herbaceous perennials for plains and for hills – Planting – Manuring Propagation.

21. Climber and creepers: Utility (aesthetic values) – Classification with suitable examples – Sunny situation – Partial shade – Shade loving climbers – Showy flowering climbers – Climbers with scented flowers – Climbers with attractive foliage – Climbers for pots – Annual climbers – Climbers for hedge making – Classification based on vegetative growth – Heavy climbers – Light climbers – Soil – Digging of pits – Planting of climbers – After care – Manuring - Maintenance. Annuals: classification- Summer annuals- Winter annuals- Flowering annuals- Foliage annuals- Propagation - Colour scheme- Grouping – After care – Maintenance

22. Palms- – Definition – Introduction – Utility (aesthetic values) – Classification with examples – Feather leaved Palm – Fan leaved Palm – Propagation – Pot culture – Potting – Re-potting - Potting media – Manuring – After care.

23. Ferns- – Introduction – Utility (aesthetic values) – Propagation – Spore – Division of Clumps –Suckers – Bulbils – Site of growing – Soil media – Pot culture – Repotting– Irrigation - Indoor culture – Important Examples. Selaginellas – Introduction – Propagation – Cultural hints – Important Examples.

24. Ornamental grasses- Bamboos and reeds – Introduction – Propagation – Soil and climatic requirements – Site of growing – Planting – Important Examples.

25. Cacti and Succulents – Introduction – Characteristics of Cactaceae – Site of growing – Natural habitat –Domestication (Housing of cacti) – Propagation – Seeds – Offsets – Grafting – Soil – Climate – Containers – Time and method of planting – Potting – Re-potting – Irrigation – Staking.

26. Pot plants: introduction – Pots – Potting – Potting- Compost – Re-potting - Arrangement, management.

27. Bio-aesthetic Planning – Definition – Aim and Concept – Need for Bio-aesthetic planning – Air pollution – Human welfare.

28. Landscaping of urban and rural areas, Peri-urban landscaping- Road side –Planting trees in colonies– Landscaping City parks – Large –Medium –Small parks – Pleasure grounds – Examples of ornamental shade and flowering trees for town roads.

29. Landscaping of schools, public places like bus station, railway station, townships, river banks, hospitals, play grounds, airports, industries, institutions. Importance – Need – Planting materials for different areas of institutions.

30. Bonsai: Definition – Criteria for selecting plants – Examples – Classification of Bonsai – Upright (formal and informal) – Production management - Production, plant layout and material handling - Winding – Oblique – Gnarled– Semi-cascadecascade – Clasped to stone – Containers (pots) and Media – Potting and Re-potting – Training – Pruning and Pinching (Shoot, leaf and root) – Watering– manuring – Defoliation – Mame Bonsai.

31&32. Computer Aided Designs (CAD) – Applications in landscaping.

### **Practical**

1. Identification of avenue trees.
2. Identification of shrubs.
3. Identification of annuals.
4. Identification of pot plants.
5. Propagation of ornamental trees.
6. Propagation of shrubs.
7. Propagation of annuals, care and maintenance of plants.
8. Potting and repotting of ornamentals.
9. Identification of tools and implements used in landscape design.
10. Training and pruning of plants for special effects.
11. Lawn establishment and maintenance.
12. Study of planning, designing and layout of formal gardens and informal gardens.
13. Layout of special type of gardens (sunken garden, terrace garden, rock garden).
14. Designing of conservatory and lath house.
15. Use of computer software.
16. Visit to important gardens/ parks/ institutes.

### **17. FINAL PRACTICAL EXAMINATION**

### **References**

1. Bhattacharjee, S. K. 2004. *Landscape Gardening and Design with plants*. Aavishkar Publishers and Distributors, Jaipur.
2. Bose, T.K. 1999. *Floriculture and Landscaping*. Naya Prakash, Kolkatta.
3. Chadha K.L and Choudhary, B. *Ornamental Horticulture in India*. ICAR, New Delhi.
4. Randhawa, G.S. and Mukhopadhyaya, A. 1998. *Floriculture in India*. Allied Publishers Pvt. Ltd., New Delhi
5. Chattopadhyay, S.K. 2007. *Commercial Floriculture*. Gene-Tech Books, New Delhi
6. Bose T.K., B. Chowdhury and S.P. Sharma 2001. *Tropical garden plants in colour*. Horticulture and Allied Publishers, Kolkata.
7. Veena Amarnath, 2012. *Nursery and Landscaping*. AGROBIOS, Jhodpur.

**Outcomes:**

- In-depth understanding the system and models of crop, data requirements, validation of models and modelling techniques for their estimation.
- Understanding the weather forecasting and verification, simulation model for preparation of Agro-advisory and its effective dissemination.

**Theory:**

**Unit I: System & Models**

System Approach for representing soil-plant-atmospheric continuum, system boundaries, Crop models, concepts & techniques, types of crop models, data requirements, relational diagrams.

**Unit II: Validation of models**

Evaluation of crop responses to weather elements; Elementary crop growth models; calibration, validation, verification and sensitivity analysis.

**Unit III: Modelling techniques**

Potential and achievable crop production- concept and modelling techniques for their estimation. Crop production in moisture and nutrients limited conditions; components of soil water and nutrients balance.

**Unit IV: Weather forecasting and verification**

Weather forecasting, types, methods, tools and techniques, forecast verification; Value added weather forecast, ITK for weather forecast and its validity;

**Unit V: Simulation and Agromet Advisory Bulletins**

Crop-Weather Calendars; Preparation of agro-advisory bulletin based on weather forecast. Use of crop simulation model for preparation of Agro-advisory and its effective dissemination.

**Practical:**

Preparation of crop weather calendars. Preparation of agro-advisories based on weather forecast using various approaches and synoptic charts. Working with statistical and simulation models for crop growth. Potential & achievable production; yield forecasting, insect & disease forecasting models. Simulation with limitations of water and nutrient management options. Sensitivity analysis of varying weather and crop management practices. Use of statistical approaches in data analysis and preparation of historical, past and present meteorological data for medium range weather forecast. Feedback from farmers about the agro advisory.

System Approach for representing soil-plant-atmospheric continuum, system boundaries, Crop models, concepts & techniques, types of crop models, data requirements, relational diagrams.

### **Lecture Schedule:**

1. System – definition – concepts.
2. Models- definition - scope.
3. Soil-plant-atmospheric continuum
4. Model- System boundaries – inputs
5. Models limitations- constrains
6. Crop models, concepts and techniques
7. Types of crop models – Abstract models and Simulation Models.
8. Input and output data requirements, relational diagrams.
9. Evaluation of crop responses to weather elements;
10. Elementary crop growth models
11. Calibration, validation, verification
12. Sensitivity analysis of models.
13. Potential and achievable crop production
14. Concept and modelling techniques for estimation of yields
15. Crop production in moisture and nutrients limited conditions;
16. Components of soil water and nutrients balance.
17. **MID SEMESTER EXAM**
18. Weather forecasting- definitions- scope
19. Types and methods of weather forecasting and tools
20. Techniques of weather forecasting and forecast verification
21. Value added weather forecast.
22. Now casting and its application.
23. National Centre for Medium Range Weather Forecasting (NCMRWF) and Agro Meteorological Field Units (AMFU) and forecasting.
24. Gramin Krishi Mausam Sewa (GKMS) and District Agromet field Units (DAMU) - role in weather forecasting.
25. Long Range Weather Forecasting (LRF)
26. ITK for weather forecast and its validity
27. Preparation of agro-advisory bulletin based on weather forecast.
28. Use of crop simulation model for preparation of Agro-advisory
29. Dissemination of weather forecasting and its mode.
30. Crop-Weather Calendars
31. IMD and its role in weather forecasting.
32. Websites and information on weather forecasting.

### **Practical Schedule**

1. Visit to Agro meteorological Observatory.
2. Preparation of crop weather calendars.
3. Preparation of agro-advisories based on weather forecast using various approaches
4. Synoptic charts
5. Working with statistical and simulation models for crop growth

6. Potential & achievable production, Yield forecasting
7. Insect & disease forecasting models.
8. Simulation with limitations of water and nutrient management options.
9. Sensitivity analysis of varying weather and crop management practices.
10. Use of statistical approaches in data analysis and
11. Preparation of historical, past and present meteorological data for medium range weather forecast.
12. Feedback from farmers about the agro advisory.
13. Visit to GKMS centre / AIR, Karaikal
14. Visit to IMD, DWRS, Karaikal
15. Visit to RMC, Chennai
16. Field visits.
17. **PRACTICAL EXAMINATION**

## References

1. Gopalaswamy, N. 1994. Agricultural Meteorology, Rawat publications, Jaipur.
2. Mavi, H.S., 1996. Introduction to Agro meteorology, oxford and IBH Publishing Co., New Delhi.
3. Narayanan.A.L.2015.Principles of Applied Agricultural Meteorology, Sri Velan Pathipagam, Chidambaram.
4. Rao, G.S.L.H.V. 2005. Agricultural Meteorology. Kerala Agricultural University Press, Thrissur.
5. Reddy, S.R. 2014. Introduction to Agriculture and Agro meteorology. Kalyani Publishers, NewDelhi. Patra, A.K. 2016. Principles and applications of Agricultural Meteorology. New India Publishing Agency, New Delhi.

## E-References:

1. [www.pajancoa.ac.in](http://www.pajancoa.ac.in)
2. [www.tawn.tnau.ac.in](http://www.tawn.tnau.ac.in)
3. [www.usbr.gov/pn/agri.met](http://www.usbr.gov/pn/agri.met)
4. [www.imd.gov.in](http://www.imd.gov.in)

## GPB 351 Commercial Plant Breeding (2+1)

### Outcomes:

- Understanding the types of crops and modes of plant reproduction, Advances in hybrid seed production techniques and Quality seed production.
- Understanding the alternative strategies for the development of commercial plant breeding and IPR issues.



## **Theory**

### **Unit I**

Types of crops and modes of plant reproduction. Line development and maintenance breeding in self and cross pollinated crops (A/B/R and two line system) for development of hybrids and seed production. Genetic purity test of commercial hybrids.

### **Unit II**

Principles and techniques of seed production, types of seeds, quality testing in self and cross pollinated crops. Advances in hybrid seed production techniques.

### **Unit III**

Hybrid seed production of maize, rice, sorghum, pearl millet, castor, sunflower, cotton pigeon pea, Brassica etc. Quality seed production of vegetable crops under open and protected environment.

### **Unit IV**

Alternative strategies for the development of the line and cultivars: haploid inducer, tissue culture techniques and biotechnological tools. Speed breeding, Rapid generation advancement, Molecular markers and Genomic selection.

### **Unit V**

IPR issues in commercial plant breeding: DUS testing and registration of varieties under PPV & FR Act. Variety testing, release, replacement rate and notification systems in India.

## **Practical**

Floral biology in self and cross pollinated species, selfing and crossing techniques. Techniques of seed production in self and cross pollinated crops using A/B/R and two line system. Learning techniques in hybrid seed production using male-sterility in field crops. Understanding the difficulties in hybrid seed production, Tools and techniques for optimizing hybrid seed production. Concept of rouging in seed production plot. Concept of line its multiplication and purification in hybrid seed production. Role of pollinators in hybrid seed production. Hybrid seed production techniques in sorghum, pearl millet, maize, rice, rapeseed-mustard, sunflower, castor, pigeon pea, cotton and vegetable crops. Sampling and analytical procedures for purity testing and detection of spurious seed. Seed drying and storage structure in quality seed management. Screening techniques during seed processing viz., grading and packaging. Visit to public private seed production and processing plants.

## **Theory schedule**

1. Types of crops and modes of plant reproduction.
2. Line development and maintenance breeding in self pollinated crops (A/B/R and two line system)
3. Principles and techniques of seed production in self pollinated crops.
4. Development of hybrids and seed production in self pollinated crops.
5. Line development and maintenance breeding in cross pollinated crops

6. Principles and techniques of seed production in cross pollinated crops.
7. Development of hybrids and seed production in cross pollinated crops.
8. Genetic purity test of commercial hybrids.
9. Types of seeds, quality testing in self and cross pollinated crops.
10. Advances in hybrid seed production techniques
11. Hybrid seed production in rice.
12. Hybrid seed production in maize.
13. Hybrid seed production in sorghum.
14. Hybrid seed production in pearl millet.
15. Hybrid seed production in castor.
16. Hybrid seed production in sunflower.
17. **Mid Semester examination**
18. Hybrid seed production in cotton.
19. Hybrid seed production in pigeon pea.
20. Hybrid seed production in brassica.
21. Quality seed production of vegetable crops under open and protected environment.
22. Hybrid seed production in tomato.
23. Hybrid seed production in brinjal and bhendi.
24. Hybrid seed production in capsicum and chilli.
25. Hybrid seed production in cucurbits, cabbage and cauliflower.
26. Alternative strategies for the development of the line and cultivars: haploid inducer and tissue culture techniques
27. Alternative strategies for the development of the line and cultivars: genetic engineering tools.
28. Speed breeding and rapid generation advancement
29. Molecular markers and Genomic selection.
30. IPR issues in commercial plant breeding
31. DUS testing and registration of varieties under PPV & FR Act.
32. Variety testing, release, replacement rate and notification systems in India.

### **Practical schedule**

1. Floral biology in self and cross pollinated species, selfing and crossing techniques.
2. Techniques of seed production in self and cross pollinated crops using A/B/R and two line system.
3. Learning techniques in hybrid seed production using male-sterility in field crops.
4. Understanding the difficulties in hybrid seed production.
5. Tools and techniques for optimizing hybrid seed production.
6. Concept of rouging in seed production plot. Concept of line its multiplication and purification in hybrid seed production.
7. Role of pollinators in hybrid seed production.
8. Hybrid seed production techniques in rice and sorghum.
9. Hybrid seed production techniques in maize and pearl millet.
10. Hybrid seed production techniques in pigeon pea and cotton.

11. Hybrid seed production techniques in rapeseed-mustard, sunflower and castor.
12. Hybrid seed production techniques in vegetable crops (brinjal, bhendi, and capsicum).
13. Sampling and analytical procedures for purity testing and detection of spurious seed.
14. Seed drying and storage structure in quality seed management.
15. Screening techniques during seed processing viz., grading and packaging.
16. Visit to public private seed production fields and seed processing plants.
- 17. Final Practical examination**

### References

- L.O. Copeland, 1999. Principles of Seed Science and Technology. Springer Publications.
- Agrawal R. L. 1999. Seed Technology. Oxford and IBH Publicity Company, New Delhi.
- N.P. Nema, 1988. Principles of seed certification and Testing. Allied Publications.
- G.N. Kulkarni, 2002. Principles of Seed Technology. Kalyani Publishers, Ludhiana.
- Arya, Prem Singh. 2003. Vegetable seed Production Principles. Kalyani Publishers. Ludhiana.
- P. Hazra and M.G. Som, 2009. Vegetable seed production and Hybrid Technology. Kalyani Publishers, Ludhiana.
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- Fageria, M. S. 2011. Vegetable Crops- Breeding and Seed Production. Kalyani Publishing. Ludhiana.
- D. N. Bharadwaj. 2012. Breeding Field Crops. Agrobios (India), Jodhpur

**HOR 351**

**PROTECTED CULTIVATION**

**(2+1)**

### Outcomes:

- In-depth understanding the importance and scope of protected cultivation, greenhouse design, poly house, types of benches and containers.
- Understanding the off-season production of flowers and vegetables, Irrigation and fertigation, management Insect pest and disease management

### Theory

#### UNIT I

Protected cultivation- importance and scope, Status of protected cultivation in India and World, types of protected structure based on site and climate.

#### UNIT II

Cladding material involved in greenhouse/ poly house. Greenhouse design, environment control, artificial lights, Automation. Soil preparation and management, Substrate management. Types of benches and containers.

### **UNIT III**

Irrigation and fertigation management. Propagation and production of quality planting material of horticultural crops.

### **UNIT IV**

Greenhouse cultivation of important horticultural crops – rose, carnation, chrysanthemum, gerbera, orchid, anthurium, lily, tulip, tomato, bell pepper, cucumber, strawberry, pot plants, etc. Cultivation of economically important medicinal and aromatic plants.

### **UNIT V**

Off-season production of flowers and vegetables. Insect pest and disease management.

### **Practical**

Raising of seedlings and saplings under protected conditions, use of protrays in quality planting material production, Bed preparation and planting of crop for production, Inter cultural operations, Soil EC and pH measurement, Regulation of irrigation and fertilizers through drip, fogging and misting.

### **Lecture outlines**

#### **Theory**

1. Protected cultivation- Importance and scope - Status of protected cultivation in India.
2. World types of protected structure based on site and climate – Glass house, poly house, rain shelters, poly tunnels, hotbeds and cold frames, shade nets.
3. Green houses – Definition- History - Green house effect – Advantages of green houses.
4. Types of green houses – Types of green houses based on shape, utility, construction and cladding material.
5. Greenhouse design – Locating a green house, green house orientation – Layout of green house – Material requirement – Erection.
6. Cladding material involved in greenhouse/ poly house – Glass, flexible plastic films, polyethylene, Ethylene Vinyl acetate, poly vinyl fluoride, poly vinyl chloride, acrylic, tefzel T2 film, reinforced plastic, rigid plastic sheet, Saran plastic mesh.
7. Environment control - Light - Supplemental lighting – Incandescent lamp, fluorescent lamp, high intensity discharge lamps - Temperature control – Heat distribution.
8. Environment control - Ventilation and cooling in a green house – Naturally ventilated, Fan and Pad cooling, forced air cooling etc. – Relative humidity, carbon dioxide level.
9. Soil preparation and management – Soil sterilization methods – Soil and soilless media (cocopeat, vermicompost, perlite, vermiculite, charcoal, pumice, rockwool etc.) - Substrate management.
10. Types of benches and containers – No bench, raised benches, ground benches – Arrangement of benches – Longitudinal, cross-benching, peninsula arrangement, movable benches, pyramid benches – Containers – Types of containers.
11. Irrigation management - Water application methods – Hand watering and automatic watering systems- Tube watering, capillary mat, overhead sprinklers, perimeter watering, drip

system, misting – Fertigation – Dry and liquid fertilizers – Methods of application of liquid fertilizers (constant feed and intermittent feed) – Carbon-di-oxide fertilization.

12. Automation – Parameters to be controlled – Types of green house control – Step control, integrated control, feedback, proportional, integral, derivative, feed forward, energy balance, sensors (Temperature, Light, CO<sub>2</sub>, Humidity, Irrigation etc.).

13. Propagation and production of quality planting material of horticultural crops – Asexual and sexual methods of propagation.

14. Greenhouse cultivation of important horticultural crops – Rose – Introduction – varieties suitable for green house cultivation – Climatic requirements – Planting – Spacing, planting density.

15. Fertilizer requirement – Fertigation – Training and pruning – Special intercultural operations (Defoliation, De-shooting, Bending, Disbudding etc.) – Use of growth regulators – Physiological disorders - Harvesting – Grading & packing – Yield.

16. Carnation - Introduction – Varieties suitable for green house cultivation – Climatic requirements – Planting – Spacing, planting density - Fertilizer requirement – fertigation – Training, pruning – Special intercultural operations (Netting, Pinching) – Use of growth regulators - Harvesting – Grading & packing – yield.

#### **17. Mid Semester examination**

18. Chrysanthemum - Introduction – Varieties suitable for green house cultivation – Climatic requirements – Planting – Spacing, planting density – Fertilizer requirement – Fertigation – Training, pruning – Special intercultural operations (pinching, disbudding, staking, de-suckering) – Use of growth regulators - Harvesting – Grading & packing – yield.

19. Gerbera - Introduction – Varieties suitable for green house cultivation – Climatic requirements – Planting – Spacing, planting density - Fertilizer requirement – Fertigation – Special intercultural operations (Defoliation, soil loosening, shading) – Use of growth regulators - Harvesting – Grading & packing – Yield.

20. Orchids - Varieties for green houses production – Climatic and substrate requirement – Propagation – Planting – Fertilizer requirement- Use of growth regulators – Physiological disorders – Harvesting – Grading and packing – Yield.

21. Anthurium - Varieties suitable for green house cultivation – Climatic requirements – Growing media - Planting – Spacing, planting density - Fertilizer requirement – Fertigation – Special intercultural operations (Defoliation, de-suckering) – Use of growth regulators - Physiological disorders- Harvesting – Grading & packing – Yield.

22. Lilium - Varieties suitable for green house cultivation – Climatic requirements – Growing media - Planting – Spacing, planting density - Fertilizer requirement – Special intercultural operations (Defoliation, de-suckering) – Use of growth regulators - Physiological disorders- Harvesting – Grading & packing – Yield.

23. Tulip - Varieties suitable for green house cultivation – Climatic requirements – Growing media - Planting – Spacing, planting density - Fertilizer requirement – Special intercultural operations (Defoliation, de-suckering) – Use of growth regulators - Physiological disorders- Harvesting – Grading & packing – Yield.

24. Tomato - Varieties suitable for green house cultivation – Climatic requirements – Soil preparation - Planting – Spacing, planting density – Training and pruning - Fertilizer requirement – Intercultural operations – Harvesting – Yield.

25. Bell pepper - Varieties suitable for green house cultivation – Climatic requirements – Soil preparation - Planting – Spacing, planting density – Training and pruning -Fertilizer requirement –Intercultural operations – Harvesting – Yield.
26. Cucumber - Varieties suitable for green house cultivation – Climatic requirements – Soil preparation - Planting – Spacing, planting density – Training and pruning - Fertilizer requirement –Intercultural operations – Harvesting – Yield.
27. Strawberry - Varieties suitable for green house cultivation – Climatic requirements – Soil preparation - Planting – Spacing, planting density – Training and pruning - Fertilizer requirement –Intercultural operations – Harvesting – Yield.
28. Pot plants – Selection of plants – Climatic requirement – Potting and Repotting – Management of pot plants.
29. Cultivation of economically important medicinal – Stevia, Ginseng and aromatic plants.
30. Off-season production of flowers and vegetables – Flower forcing – Techniques – Vegetable forcing – Techniques.
31. Insects of greenhouse crops – Springtails, beetles, sawflies, aphids, thrips, red spider mites, slugs and snails, symphilids, millipedes etc and their management – Integrated Pest management in Green house.
32. Disease management in green houses – Bacterial blight, bacterial canker, bacterial leaf spots- Viral diseases - Tomato spotted wilt virus – Fungal Diseases – Downy Mildew, Powdery mildew, Sclerotinia rot, Damping off – Nematodes and their management.

### **Practical**

1. Study of different types of green houses based on shape.
2. Study of different types of green houses based on construction.
3. Study of different types of green houses based on cladding material.
4. Study of materials for construction of greenhouses.
5. Study of construction of pipe framed green house.
6. Measurement of environmental parameters inside greenhouse.
7. Calculation of ventilation rates in active summer cooling system.
8. Calculation of rate of air exchange in active winter cooling system.
9. Field visit to green house.
10. Raising of seedlings and saplings under protected conditions.
11. Use of protrays in quality planting material production.
12. Bed preparation and planting of crop for production.
13. Intercultural operations.
14. Soil EC and pH measurement.
15. Regulation of irrigation.
16. Fertilizers through drip, fogging and misting.

### **17. FINAL PRACTICAL EXAMINATION**

#### **References**

1. Vilas M. Salone and Ajay K. Sharma.2012. *Greenhouse Technology and Applications*. Agrotech Publishers. New Delhi.
2. S. Prasad and U. Kumar. 2012. *Greenhouse Management of Horticultural Crops*. Second edition, Agrobios. New Delhi

3. Joe.J.Hanan. 1998. *Green houses: Advanced Technology for Protected Horticulture*, CRC Press, LLC. Florida.
4. K.Radha Manohar and C. Igathinathane, 2013. *Greenhouse Technology and Management* BS Publications.
5. Paul V. Nelson. 1991. *Green House Operation and Management*. Ball publishing USA.

**HOR 352**

**HI-TECH HORTICULTURE**

**(2+1)**

Outcomes:

- In-depth understanding the importance of management and micro propagation, Modern field preparation and planting methods.
- Understanding micro irrigation systems and components of precision farming and application in horticultural crops.

#### **UNIT I**

Introduction & importance; Management and mechanization in horticultural nursery; Micro propagation of horticultural crops

#### **UNIT II**

Modern field preparation and planting methods, Protected cultivation: advantages, controlled conditions, method and techniques

#### **UNIT III**

Micro irrigation systems and its components; EC, pH based fertilizer scheduling, canopy management, high density orcharding

#### **UNIT IV**

Components of precision farming: Remote sensing, Geographical Information System (GIS), Differential Geo-positioning System (DGPS), Variable Rate applicator (VRA)

#### **UNIT V**

Application of precision farming in horticultural crops (fruits, vegetables and ornamental crops); mechanized harvesting of produce.

#### **Practical**

Types of Polyhouses and shade net houses, intercultural operations, tools and equipments identification and application, micro propagation, nursery-portrays, microirrigation, EC, pH based fertilizer scheduling, canopy management, visit to hi-tech orchard/nursery.

#### **Theory**

1. Hi-tech horticulture – Introduction - Scope and importance – Perspectives of Hi-tech horticulture in India.

2. Nursery management – Quality control of planting material- Plastics in nursery management – Advantages of plant propagation under green houses (Hi-tech nursery).
3. Mechanization – Importance of mechanisation in Hi-tech horticulture – Mechanisation of nursery, sowing and transplanting, plastic mulching, irrigation, fertigation, pest and disease control, weed control, harvesting etc.
- 4 & 5. Micro propagation of horticultural crops – Meristem culture - Various approaches of shoot multiplication – Applications of micro propagation – Problems in micropropagation - Advantages and limitations – Micro-grafting.
6. Modern field preparation methods – Raised bed preparation – Plastic mulching.
7. Modern planting methods – Container planting - Soil less culture – Hydroponics, aeroponics.
8. Protected cultivation- Advantages- Types of protected structures - Glass house, poly house, rain shelters, poly tunnels, hotbeds and cold frames, shade nets etc.
- 9 & 10. Greenhouse – Advantages- Controlled conditions – Light, Humidity, Temperature, CO<sub>2</sub> - Ventilation and cooling in a green house – Naturally ventilated, fan and pad cooling, forced air cooling etc. – Relative humidity, carbon-di-oxide level.
- 11 & 12 Micro irrigation systems and its components – Methods of micro irrigation (Surface drip, sub-surface drip irrigation, Bubblers, micro sprinkler etc.) - Maintenance of micro irrigation system.
- 13 Fertigation – Advantages –Limitations - Method of fertilizer injection ( Fertilizer injection system, Pressure differential injection system, Venturi injection system) – Selection of fertilizers – Solid fertilizers & liquid fertilizers.
- 14 EC, pH based fertilizer scheduling – Site specific nutrient management – Advantages and disadvantages.
- 15 & 16 Canopy management – Importance of canopy management- principles of canopy management – Tools of canopy management (Rootstocks, plant density, training and pruning, nutrient management, growth retardants etc.).

## **17. Mid Semester Examination**

18. High Density orcharding – Concept – HDP systems – Components of HDP (use of genetically dwarf scion cultivars, dwarf rootstocks, pruning and training, use of growth retardants, induction of viral infection, use of incompatible rootstocks etc.) – Impact of HDP- Advantages- Constraints in HDP.
19. Precision farming – Definition – Scope and status of precision farming in India- Perspectives and potentials of precision farming in India - Components of precision farming.
- 20 & 21 Remote sensing – Role of remote sensing in precision farming - Application of remote sensing in the field of horticulture.
- 22 Geographical Information System (GIS) – Role of GIS in precision farming.
- 23 & 24. Differential Global Positioning System (DGPS) – GPS introduction - Types of GPS - DGPS uses in Agriculture - Yield monitoring, field mapping, precision crop input application (fertilizers, pesticides, weedicides etc.).
- 25 & 26. Variable Rate applicator (VRA) – Introduction – Variable rate application methods – map based VRA and Sensor based VRA – VRA management zones – Seeding VRA, Weed control VRA, Lime VRA, Fertilizer VRA.



27, 28 & 29. Precision farming – Applications of precision farming in horticultural crops (fruits, vegetables and ornamental crops) – Strategic approaches of precision technology for improvement of fruit production.

30. Mechanized harvesting of produce – Advantages and disadvantages of mechanical harvesting – Mechanical harvesters developed for different horticultural crops – Robots in harvesting.

31 & 32. Green food production – Approaches – Biodynamic farming – Biodynamic preparations – Cosmic integration – Biodynamic calendar – Strategies for green food production.

### **Practical**

1. Study of types of polyhouses.
2. Study of shade net houses.
3. Intercultural operations in Hi – tech horticulture.
4. Identification and application of tools and equipments.
5. Micro propagation.
6. Nursery raising in portrays.
7. Study of Micro-irrigation system and its components.
8. Problems of micro irrigation system.
9. Estimation of EC of soil and water.
10. Estimation of pH in soil and water.
11. Fertilizer scheduling.
12. Canopy management in Mango.
13. Canopy management in Guava.
14. Canopy management in Grapes.
15. Visit to Hi-Tech orchard.
16. Visit to Hi-Tech nursery.

### **17. FINAL PRACTICAL EXAMINATION**

### **References**

1. Prasad, S. And Kumar, U. 2012. *Greenhouse Management of Horticultural Crops*. 2<sup>nd</sup> edition, Agribios publishers, New Delhi.
2. Singh, H.P., Singh, G., Samuel, J.C., and Pathak, R.K.. 2003. *Precision Farming in Horticulture*. NCPAH, MOA, PFDC, CISH, Lucknow
3. Srivasthava, K.K.. 2007. *Canopy Management of Fruit Crops*. International book distributing co., Lucknow
4. Sahu, K.C. 2008. *Text Book of Remote Sensing and Geographical Information Systems*. Atlantic publishers & Distributors

## **GBP 352 MICRO-PROPAGATION TECHNOLOGIES (2+1)**

### **Outcomes:**

- In-depth understanding the meaning and concept of *in vitro* culture and micro propagation, compounds of tissue culture and Haploid culture.
- Understanding the Public and private organizations involvement, National certification and Quality management, Project proposal for establishing a commercial Tissue culture lab.

### **Theory Course outlines**

#### **Unit I:**

Meaning and concept of *in vitro* culture and micro-propagation. Different concepts employed in micropropagation. Historical mile stones, advancement and future prospects of micropropagation; totipotency, dedifferentiation. Applications, advantages and limitations of tissue culture techniques. Tissue culture methodology: Sterile techniques, synthetic and natural media components, growth regulators, environmental requirement, genetic control of regeneration. Techniques of sterilization/asepsis for glass and metal ware, liquids both thermo stable and thermolabile and disposal of remnants of culture. Laboratory organization, requirements, layout of small, medium and large scale Tissue culture laboratories.

#### **Unit II:**

Components of the tissue culture media – Inorganic nutrients, vitamins, amino acids and other organic supplements, carbon source, hormones/ plant growth regulators, pH of the media, gelling agents. Different types of media. Preparation of media – Stocks and working media, preparation and storage. Plant regeneration pathways-Organogenesis and Somatic embryogenesis. Organo genesis-Purpose, methods and requirements for organogenesis, indirect and direct organogenesis. Somatic embryo genesis – Procedures and requirements for organogenesis, indirect and direct embryogenesis; Differences between somatic and gametic embryogenesis,

#### **Unit III:**

Haploid culture- Anther culture, pollen culture and Ovary culture- applications and limitations. Synthetic seed- Concepts, necessity, procedure and requirements for production of synthetic seeds. Artificial seed. Micro-propagation – Definition, methods, stages of micro-propagation and its significance. Axillary bud proliferation approach – Shoot tip and meristem culture. Factors affecting micropropagation-applications and limitations. Advancements and future prospects of *in vitro* culture – Techniques of single cell culture, suspension cultures. Applications of organ culture - Meristem tip culture (virus free plants) and anther culture (doubled haploids). Production of secondary metabolites through cell culture techniques.

#### **Unit IV:**

Micropropagation-Definition, stages of micropropagation-Factors affecting micropropagation – applications and limitations. Micropropagation techniques in Banana, Neem, Bamboo,

Cassuarina, Sugarcane, *Eucalyptus*, *Aloe vera*, *Phyllanthus*, Gerbera, Coleus, Rose, Chrysanthemum and Orchids.

### **Unit V:**

Primary hardening of tissue cultured plants –requirements and layout of polyhouse. Secondary hardening of Tissue cultured plants- Requirements and layout of shade net provision. National certification and Quality management of TC plants. Genetic fidelity test and virus indexing in TC plants. Production of secondary metabolites through cell culture techniques. Public and private organizations involved in Plant Tissue culture in India. Preparation of Project proposal for establishing a commercial Tissue culture lab.

### **Practical outline**

Laboratory organization, Laboratory organization small, medium and large scale laboratories. Sterilization techniques for explants, glassware, plasticwares, labwares and working platform. Preparation of stocks and working solution. Preparation and sterilization of growth regulators. Preparation of working medium and Experimentation on determining optimum concentration of growth regulators. Callus induction and regeneration of whole plants from different parts of plants. Direct regeneration into whole plants using bud, node and other tissues. Induction of somatic embryos. Experiments of synthetic seeds production and testing storability and germination efficiency.

### **Theory Lecture Schedule**

1. Meaning and concept of *in vitro* culture, micropropagation, totipotency, dedifferentiation. Different concepts employed in tissue culture. Scope of Plant Tissue culture.
2. Historical mile stones, advancement and future prospects of micropropagation; totipotency, dedifferentiation.
3. Different tissue culture techniques- applications, advantages and limitations.
4. Layout of Tissue culture, requirements and types- small, medium and large scale laboratories. Environmental requirements of Tissue culture unit.
5. Techniques of sterilization/asepsis for glass and metal ware, liquids both thermo stable and thermo labile, disposal of remnants of culture.
6. Components of the tissue culture media – Inorganic nutrients, vitamins, amino acids and other organic supplements.
7. Components of the tissue culture media- carbon source, hormones/ plant growth regulators, pH of the media, gelling agents.
8. Preparation of media – Stocks and working media, preparation and storage.
9. Genetic control of regeneration. Pathways of regeneration of plants and Regeneration methods- morphogenesis, organogenesis and embryogenesis.
10. Organogenesis-Purpose, methods and requirements for organogenesis, indirect and direct organogenesis.
11. Somatic embryogenesis and factors affecting somatic embryogenesis - Differences between gametic and somatic embryos.
12. Culture types - callus culture and cell suspension culture; shoot tip and meristem tip culture. Applications and limitations.

13. Auxillary bud proliferation, shoot tip and meristem culture- application and limitations.
14. Anther culture, pollen culture and ovary culture- applications and limitations.
15. Production of virus free plants through Meristem tip culture.
16. Synthetic seeds and Artificial seed – Concept, necessity, procedure and requirements of synthetic seeds.

#### 17. MID SEMESTER

18. Micropropagation-Definition, stages of micropropagation-Factors affecting micropropagation –applications and limitations.
19. Micropropagation techniques in Banana and Neem
20. Micropropagation techniques Bamboo and Cassuarina
21. Micropropagation techniques in Sugarcane and *Eucalyptus*
22. Micropropagation techniques in *Aloe vera* and *Phyllanthus*
23. Micropropagation techniques in Gerbera and Coleus
24. Micropropagation techniques in Rose and Chrysanthemum
25. Micropropagation techniques in Orchids
26. Primary hardening of tissue cultured plants –requirements and layout of polyhouse.
27. Secondary hardening of Tissue cultured plants- requirements and layout of shade net provision.
28. National certification and Quality management of TC plants
29. Genetic fidelity test and virus indexing in TC plants.
30. Production of secondary metabolites through cell culture techniques.
31. Public and private organizations involved in Plant Tissue culture in India.
32. Preparation of Project proposal for establishing a commercial Tissue culture lab.

#### Practical schedule

1. Organization of tissue culture laboratory- small, medium and large scale laboratory layout.
2. Sterilization techniques used in tissue culture laboratory – Glass, plastic and metal ware.
3. Study and use of laminar flow unit for tissue culture.
4. Study and use of autoclaves for tissue culture.
5. Preparation of stock and working solutions of tissue culture media.
6. Sterilization techniques used in tissue culture laboratory media.
7. Filter Sterilization thermo labile compounds-Hormones and Vitamines and Aminoacids.
8. Preparation and inoculation of explants for direct organogenesis – Shoot tip, nodal explants.
9. Preparation and inoculation of explants for callus production – Leaf, stem and root explants.
10. Determination of optimum concentration of hormones/ growth regulators for direct organogenesis – Shoots.
11. Determination of optimum concentration of hormones/ growth regulators for direct organogenesis – Roots.
12. Sub culturing for multiple shoots and calli produced in vitro.
13. Determination of optimum concentration of auxins to generate shoots from *in vitro* generated calli.
14. Preparation of synthetic seeds from somatic embryos and its storage.

15. Visit to commercial Tissue culture lab.
16. Visit to Accredited Tissue Culture lab/NRC Banana, Trichy

### **17. FINAL PRACTICAL EXAMINATION**

#### **References**

1. Gamborg, O.L. and Phillips, G.C. 1995. Plant Cell Tissue Organ Culture : Fundamental Methods. Springer, Berlin.
2. Keshavachandran, R. and Peter, K.V. 2008. Plant Biotechnology: Methods in Tissue Culture and Gene Transfer. Universities Press, Hyderabad. 224
3. Smith, R.H., 2013. Plant Tissue Culture : Techniques and Experiments. 3rd ed. Academic Press, San Diego, CA, USA.
4. Bhojwani, S.S. and Razdan, M.K. 1996. Plant Tissue Culture, Theory and Practice. Elsevier, Netherlands.
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## **AGM 352      APPLIED MICROBIOLOGY      (2+1)**

#### **Outcomes:**

- In-depth understanding the factors affecting microorganisms in food-Intrinsic factors, food preservation, physical & chemical methods, Food poisoning, intoxication, milk-contamination and preservation.
- Understanding the Industrial Microbiology, Health and Environmental Microbiology and Bioenergy and Recombinant products.

#### **Theory**

##### **Unit I: Food Microbiology**

Microbial spoilage of foods-cause and ease of spoilage; Factors affecting microorganisms in food-Intrinsic factors, Factors affecting microorganisms in food-Extrinsic factors; Principles of food preservation-physical methods, chemical methods; Food poisoning, intoxication.

##### **Unit II: Dairy and fermentation Microbiology**

Microbes in milk-contamination and preservation; Spoilage of milk; Fermented milk products; Fermented foods; Fermentation of tea, coffee and cocoa; Production of single cell protein; Production of alcoholic beverages-beer, wine, and distilled alcoholic beverages.

##### **Unit III: Industrial Microbiology**

Microbial production of primary and secondary metabolites-organic acids, amino acids, enzymes, vitamins, antibiotics; Microbial polysaccharides; Microbial phytohormones; Microbial pigments.

#### **Unit IV: Health and Environmental Microbiology**

Probiotics, prebiotics and synbiotics. Microbial biotransformations; Biodegradation of agrowastes- composting types; Bioremediation-importance, degradation of oils, xenobiotic compounds; Biomining.

#### **Unit V: Bioenergy and Recombinant products.**

Microbes in genetic engineering-vectors, plasmids, transposons; Recombinant DNA products using microbes; Biomass to biofuel-ethanol production, biogas generation; Hydrogen production , electricity generation.

#### **Practical**

Enumeration of microorganisms in food, Microbiological examination of spoiled meat/fish, milk and milk products; Fermented products-Wine making, Saurekraut preparation; Isolation of probiotic microorganism-LAB from curd/idli batter; Isolation of yeast from fruit juice; Isolation of *Acetobacter acetii* from fruit juice; Production of vinegar; Application of yeast in leavening of dough ; Application of enzymes in fruit juice clarification, meat tenderization; Isolation of antibiotic producing microorganism by crowded plate technique, Identification of antibiotic activity by cross streak assay/agar well diffusion technique; Isolation of microorganisms from compost and Bioconversion of agricultural waste by composting.

#### **Theory schedule**

1. Microbial spoilage of foods-cause and ease of spoilage
2. Factors affecting microorganisms in food-Intrinsic factors,
3. Factors affecting microorganisms in food-Extrinsic factors
4. Principles of food preservation-physical methods
5. Principles of food preservation-chemical methods
6. Food poisoning, intoxication
7. Microbes in milk-contamination and preservation
8. Spoilage of milk
9. Fermented milk products
10. Fermented foods-Saurekraut, kefir, tempeh, miso etc.,
11. Fermentation of tea, coffee and cocoa
12. Production of single cell protein
13. Production of alcoholic beverages-beer, wine
14. Production of distilled alcoholic beverages
15. Microbial production of organic acids-citric acid, acetic acid
16. Microbial production of amino acids-glutamic acid, lysine, tryptophan
17. Mid semester examination
18. Microbial production of enzymes-amylase, protease
19. Microbial production of vitamins-B12, Riboflavin
20. Microbial production of antibiotics- types, penicillin production
21. Microbial polysaccharides
22. Microbial phytohormones and pigments
23. Probiotics-importance, application.

24. Prebiotics and synbiotics
25. Microbial biotransformations-types and significance
26. Biodegradation of agrowastes-composting types
27. Microbiology of composting-succession of microbes during composting.
28. Bioremediation-importance, degradation of oils, xenobiotic compounds; Biomining
29. Microbes in genetic engineering-vectors, plasmids, transposons
30. Recombinant DNA products using microbes
31. Biomass to biofuel-ethanol production, biogas generation
32. Hydrogen production, electricity generation

## **Practical**

1. Enumeration of microorganisms in food
2. Microbiological examination of spoiled meat/fish
3. Microbiological examination of milk and milk products
4. Fermented products-Wine making
5. Fermented products-Sauerkraut preparation
6. Isolation of probiotic microorganism-LAB from curd/idli batter
7. Isolation of yeast from fruit juice
8. Isolation of *Acetobacter acetii* from fruit juice
9. Production of vinegar
10. Application of yeast in leavening of dough
11. Application of enzymes in fruit juice clarification
12. Application of enzymes in meat tenderization
13. Isolation of antibiotic producing microorganism by crowded plate technique
14. Identification of antibiotic activity by cross streak assay/agar well diffusion technique
15. Isolation of microorganisms from compost
16. Bioconversion of agricultural waste by composting.
17. Final practical examination

## **References :**

1. Food Microbiology by W.C.Frazier and D.C.Westhoff. Tata McGraw-Hill publ.Co. Ltd., New Delhi
2. Biotechnology: A Text Book of Industrial Microbiology by W.Crueger and A.Crueger. English edn. By T.D. Brock. Sinauer Assoc. Inc. Sunderland, USA.
3. Food Biotechnology In: Advances in Biochemical engineering, Biotechnology series 111, (2008) Springer verlag, Berlin.
4. Fundamentals of Food Biotechnology by B.H.Lee. Wiley Blackwell Publ. 2015.
5. Beneficial microorganisms in food and Nutraceuticals (Ed) Min-Tze Liong. Microbiology Monograph vol. 27; Springer, Berlin.
6. Industrial microbiology: An Introduction by M.J.Waites et.al., (2001) Blackwell science Ltd., Oxford.

## **SAC 352 Agrochemicals (2+1)**

### **Outcomes:**

- In-depth understanding the role and type in agrochemicals, organic fungicides and insecticides of classification and Fate of herbicides.
- Understanding the importance of Fertilizers and their importance, Mixed and complex fertilizers, Fertilizer control, Fertilizer logistics and marketing.

### **Theory**

#### **Unit I – Agrochemicals and Fungicides**

An introduction to agrochemicals, their type and role in agriculture, effect on environment, soil, human and animal health, merits and demerits of their uses in agriculture, management of agrochemicals for sustainable agriculture.

Fungicides - Classification – Inorganic fungicides - characteristics, preparation and use of sulfur and copper, Mode of action-Bordeaux mixture and copper oxychloride. Organic fungicides- Mode of action- Dithiocarbamates -characteristics, preparation and use of Zineb and maneb. Systemic fungicides - Benomyl, carboxin, oxycarboxin, Metalaxyl, Carbendazim, characteristics and use

#### **Unit III - Insecticides**

Introduction and classification of insecticides: inorganic and organic insecticides Organochlorine, Organophosphates, Carbamates, Synthetic pyrethroids Neonicotinoids, Biorationals,

#### **Unit II – Herbicides, Bio pesticides and Insecticide Act**

Herbicides-Major classes, properties and important herbicides. Fate of herbicides.

IGRs Biopesticides, Reduced risk insecticides, Botanicals, plant and animal systemic insecticides their characteristics and uses. Plant bio-pesticides for ecological agriculture, Bio-insect repellent.

Insecticide Act and rules, Insecticides banned, withdrawn and restricted use, Fate of insecticides in soil & plant.

#### **Unit IV - Fertilizers**

Fertilizers and their importance. Nitrogenous fertilizers: Feedstocks and Manufacturing of ammonium sulphate, ammonium nitrate, ammonium chloride, urea. Slow release N-fertilizers. Phosphatic fertilizers: feedstock and manufacturing of single superphosphate. Preparation of bone meal and basic slag. Potassic fertilizers: Natural sources of potash, manufacturing of potassiumchloride, potassium sulphate and potassium nitrate.



## Unit V – Mixed, complex fertilizers and FCO

Mixed and complex fertilizers: Sources and compatibility–preparation of major, secondary and micronutrient mixtures. Complex fertilizers: Manufacturing of ammonium phosphates, nitrophosphates and NPK complexes. Fertilizer control order. Fertilizer logistics and marketing.

### Practical

Sampling of fertilizers and pesticides. Pesticides application technology to study about various pesticides appliances. Quick tests for identification of common fertilizers. Identification of anion and cation in fertilizer. Calculation of doses of insecticides to be used. To study and identify various formulations of insecticide available in market. Estimation of nitrogen in Urea. Estimation of water soluble  $P_2O_5$  and citrate soluble  $P_2O_5$  in single super phosphate. Estimation of potassium in Muriate of Potash/ Sulphate of Potash by flame photometer. Determination of copper content in copper oxychloride. Determination of sulphur content in sulphur fungicide. Determination of thiram. Determination of ziram content.

### Theory schedule

1. An introduction to agrochemicals, their type and role in agriculture.
2. Effect of agro chemicals on environment, soil, human and animal health, merits and demerits of their uses in agriculture.
3. Management of agrochemicals for sustainable agriculture.
4. Fungicides - Classification – Inorganic fungicides - characteristics, preparation and use of sulfur and copper, Mode of action-Bordeaux mixture and copper oxychloride
5. Inorganic fungicides - Mode of action - Bordeaux mixture and copper oxychloride
6. Organic fungicides- Mode of action- Dithiocarbamates-characteristics, preparation and use of Zineb and maneb.
7. Systemic fungicides - Benomyl, carboxin, oxycarboxin, Metalaxyl, Carbendazim, characteristics and use.
8. Introduction and classification of insecticides: inorganic and organic insecticides.
9. Organochlorine insecticides: properties and mode of action.
10. Organophosphates- properties and mode of action.
11. Carbamates- properties and mode of action.
12. Synthetic pyrethroids- properties and mode of action.
13. Neonicotinoids- properties and mode of action.
14. Biorationals- mode of action, toxicity, formulation and use
15. **Mid semester examination**
16. Herbicides-.Definition, advantage and limitation of their usage, classification.
17. Major classes, properties and important herbicides, Fate of herbicides
18. IGRs - mode of action, toxicity, formulation and use
19. Bio pesticides and Reduced risk insecticides.
20. Plant bio-pesticides for ecological agriculture, Bio-insect repellent.

21. Insecticide Act and rules, Insecticides banned, withdrawn and restricted use, Fate of insecticides in soil & plant.
22. Botanicals, plant and animal systemic insecticides their characteristics and uses
23. Fertilizers and their importance, classification, Nitrogenous fertilizers: Feedstock and Manufacturing of ammonium sulphate, ammonium nitrate, ammonium chloride
24. Feedstock and Manufacturing of urea and Slow release N-fertilizers.
25. Phosphatic fertilizers: feedstock and manufacturing of single superphosphate. Preparation of bone meal and basic slag.
26. Potassic fertilizers: Natural sources of potash, manufacturing of potassium chloride, potassium sulphate and potassium nitrate
27. Mixed and complex fertilizers: Sources, advantages and disadvantages over straight fertilizers. Compatibility of fertilizer physical and chemical problems associated with bulk blending of fertilizers.
28. Complex fertilizers: Manufacturing of ammonium phosphates, nitro phosphates.
29. Complex fertilizers - NPK complexes.
30. Preparation of major, secondary, micronutrient mixtures and multi nutrient fertilizers.
31. Fertilizer control order – fertilizer storage standards
32. Fertilizer logistics and marketing.

### **Practical schedule**

1. Sampling of fertilizers and pesticides.
2. Study and identification of various agrochemicals and its formulation available in market.
3. Calculation of doses of fertilizers.
4. Calculation of doses of herbicides and fungicides.
5. Calculation of doses of insecticides.
6. Application technology to study about various pesticides appliances.
7. Quick tests for identification of common fertilizers.
8. Identification of anion and cation in fertilizers.
9. Estimation of Nitrogen in Urea.
10. Estimation of water soluble  $P_2O_5$  in single super phosphate.
11. Estimation of citrate soluble  $P_2O_5$  in phosphatic fertilizer
12. Estimation of potassium in Muriate of Potash/ Sulphate of Potash by flame photometer.
13. Determination of copper content in copper oxychloride.
14. Determination of sulphur content in sulphur fungicide.
15. Determination of active ingredient content in Thiram
16. Determination of active ingredient content in ziram.
- 17. Practical examination**

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1. Handa.S.K.2004. Principles of Pesticide Chemistry. Agrobios
2. Cremllyn, R.J. 1991. Agrochemicals Preparation and mode of action. John Wiley and sons, New york.
3. George W.Ware, 1986. Fundamentals of Pesticides - A Self Instruction Guide Thomas Publications, PO Box.9335, Freno, California 93791.
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9. Tandon, H.L.S. 1994. Fertilizer, Organic Manures, Recyclable Wastes and Biofertilizers Fertilizer Development and Consultation Organization, New Delhi.
10. Manickam, T.S and Mariakulandai. A. Chemistry of manure and fertilizers. **Aria publishing house, New York.**

## Web resources

1. [www.fspublishers.org/ijab/past-issues/IJABVOL\\_5\\_NO\\_3/47.pdf](http://www.fspublishers.org/ijab/past-issues/IJABVOL_5_NO_3/47.pdf)
2. [www.springerlink.com/index/I011256h8t325054.pdf](http://www.springerlink.com/index/I011256h8t325054.pdf)
3. [agtr.ilri.cgiar.org/agtrweb/Documents/Library/docs/.../Module4.htm](http://agtr.ilri.cgiar.org/agtrweb/Documents/Library/docs/.../Module4.htm)
4. [www.fao.org/wairdocs/ilri/x5546e/x5546e08.htm](http://www.fao.org/wairdocs/ilri/x5546e/x5546e08.htm)
5. [www.energy.ca.gov/process/agriculture/ag\\_pubs/fertigation.pdf](http://www.energy.ca.gov/process/agriculture/ag_pubs/fertigation.pdf) -
6. [www.soilandhealth.org/.../010117attraoilmanual/010117attra.html](http://www.soilandhealth.org/.../010117attraoilmanual/010117attra.html)