



PONDICHERRY UNIVERSITY
PUDUCHERRY 605 014

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

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



PANDIT JAWAHARLAL NEHRU COLLEGE OF
AGRICULTURE AND RESEARCH INSTITUTE

(A Government of Puducherry Institution)

Affiliated to Pondicherry University and Accredited by ICAR & NAAC

KARAIKAL – 609 603, UT of Puducherry



**PONDICHERRY UNIVERSITY
PUDUCHERRY – 605 014**

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

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

01. REGULATIONS

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

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

02. SHORT TITLE AND COMMENCEMENT

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

03. DEFINITIONS

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

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

- 3.17 **'Non-Gradial course'** means a course which is compulsorily registered by the student for the completion of undergraduate programme. The non-gradial courses shall be evaluated as 'Satisfactory' or 'Not-satisfactory'. The marks obtained by the student in a non-gradial course will not be taken into account for calculating OGPA.
- 3.18 **'Online course'** means a course which a student will have to take in on-line mode, as partial requirement of the B.Sc. (Hons.) Degree Programme. The online courses can be from any field such as Basic Sciences, Humanities, Psychology, Anthropology, Economics, Engineering, Business Management, Languages including foreign language, Communication skills/ Music, etc., and can be taken from NPTEL, mooKIT, edX, Coursera, SWAYAM or any other online portal.
- 3.19 **'Internship'** means various activities such as experiential learning/ hands on training/ skill development training/ Rural Agricultural / Horticultural Work Experience (RAWE) / (RHWE), in-plant training / industrial attachment. Those students who wish to exit with UG Certificate after one year, have to undergo 10 weeks of internship programme after First year. Similarly, those students who wish to exit with UG Diploma after Second year, have to undergo 10 weeks of internship programme after Second year. Internship shall be arranged outside the institution at any assigned organization/industry/research institute/ project or with a progressive farmer/agri enterprise.
- 3.20 **'UG Certificate'** candidates who exit after completing first year of UG programme (First and second semesters) and 10 weeks of internship shall be awarded with a UG Certificate in Agriculture/Horticulture.
- 3.21 **'UG Diploma'** Candidates who exit after completing second year of UG programme (First four semesters) and 10 weeks of internship shall be awarded with a UG Diploma in Agriculture/Horticulture.
- 3.22 **'UG Degree'** candidates who successfully complete all the prescribed courses and students READY programme shall be awarded with a B.Sc. (Hons.) degree in Agriculture/Horticulture.
- 3.23 **'Credit Load'** of a student during a semester is the total number of credits of all the courses including non-gradial courses, a student registers during that particular semester.
- 3.24 **'A credit'** in theory means 50 minutes of class room lecture and a credit in practical means two hours of laboratory or workshop or field work per week.
Explanation: A 1+1 course (2 credits) means 50 minutes of theory and 2 hours practical per week.
 A 0+1 course (1 credit) means 2 hours practical per week.
 A 1+0 course (1 credit) means 50 minutes theory per week.
- 3.25 **'Grade Point'** means the total marks in percentage obtained in a course divided by 10 and rounded to two decimal places.

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

04. ELIGIBILITY FOR ADMISSION TO UNDER GRADUATE PROGRAMMES

4.1 Eligibility for entry into first year of UG programme

4.1.1 H.Sc. / Equivalent - Academic Stream

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

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

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

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

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

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

Other State Vocational stream students are not eligible to apply.

4.1.3 Eligible Minimum Qualifying Marks (Academic Stream)

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

4.1.4 Number of Attempts to pass

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

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

* including first appearance

4.1.5 Age limit

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

4.2 Eligibility for lateral entry into second year of UG programme

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

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

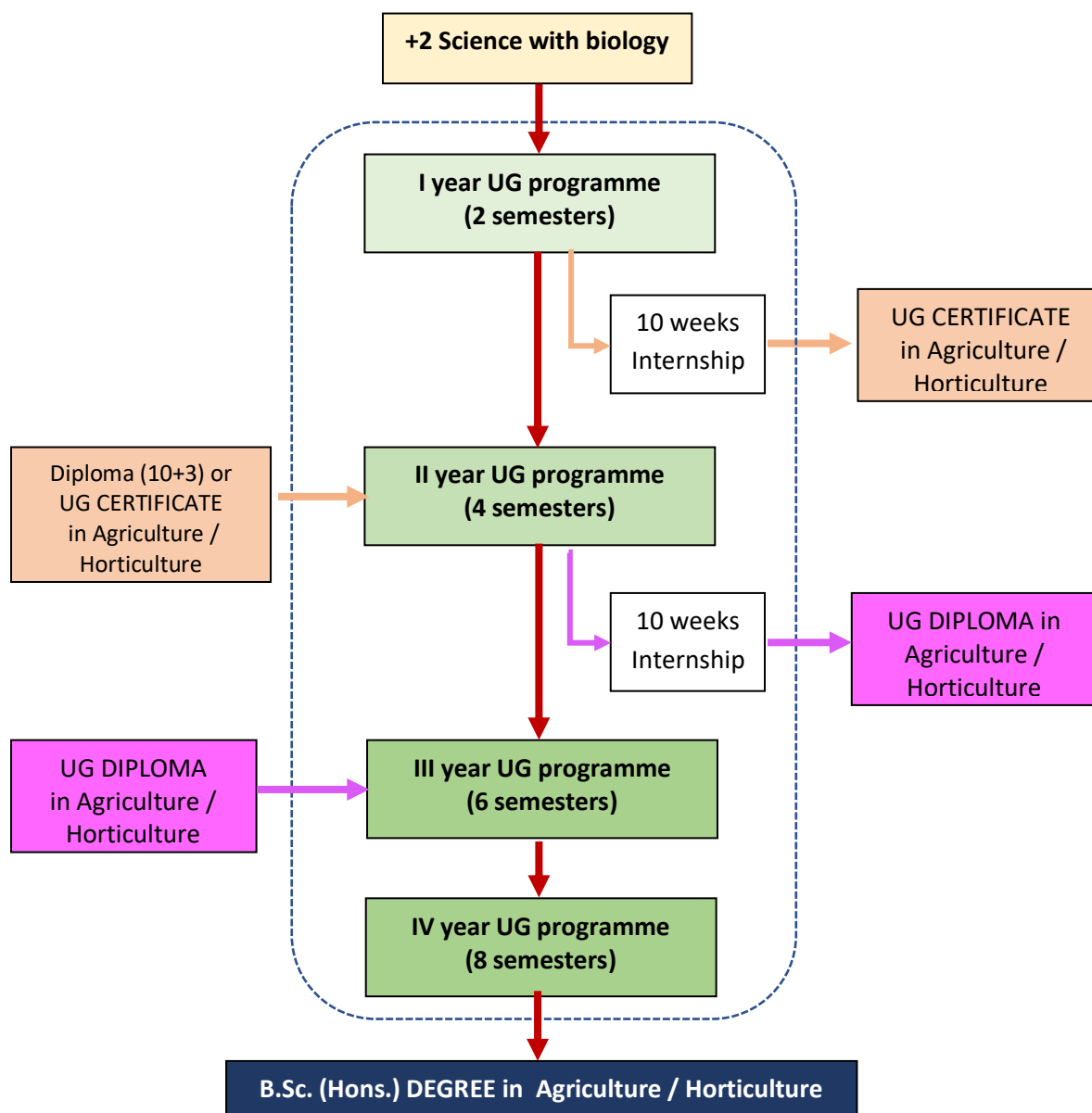
- iv) Candidates with 50% of the maximum marks/ OGPA of the concerned diploma/ UG Certificate programme are only eligible to apply for lateral entry into second year of UG Programme.
- v) Reservation policy is not applicable for lateral entry into second year of UG programme.
- vi) There is no upper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

4.3 Eligibility for lateral entry into third year of UG programme

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

4.4 Migration

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



Frame work of undergraduate programme

05. SYSTEM OF EDUCATION

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

06. ATTENDANCE REQUIREMENTS

6.1 Minimum Attendance requirement

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

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

6.4 Calculation of Attendance

a) THEORY

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

b) PRACTICAL

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

07. EVALUATION OF STUDENT'S PERFORMANCE

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

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

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

7.3 Grade Point

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

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

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

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

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

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

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

7.6 Announced Quiz

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

7.7 Mid Semester Examination (Internal)

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

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

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

7.7.1 Missing Mid-semester Examination

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

7.8 Assignment

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

7.9 Record / Progressive Assessment

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

7.10 Final Theory Examination (External)

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

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

7.10.1 Postponement of Final Theory Examination

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

7.11 Final Practical Examination (Internal)

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

7.12 Arrear Examination

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

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

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

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

7.16 Question paper pattern

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

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

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

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

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

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

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

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

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

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

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

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

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

7.18 Evaluation of courses with only practical credits

7.18.1 Evaluation pattern for Skill Enhancement Courses (SEC)

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

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

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

7.18.3 Evaluation pattern for PED/ NCC /NSS

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

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

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

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

7.18.5 Evaluation pattern for Student READY

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

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

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

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

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

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

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

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

7.19 Return of valued answer papers

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

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

7.20 Revaluation / Re-totalling

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

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

8. MALPRACTICES IN EXAMINATION

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

9. REGISTRATION OF ELECTIVE COURSES

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

10. REGISTRATION OF SKILL ENHANCEMENT COURSES

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

11. STUDY TOUR

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

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

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

12. DISCONTINUANCE AND RE-ADMISSION

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

13. CALCULATION OF OGPA

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

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

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

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

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

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

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

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

15. REMOVAL OF DIFFICULTIES

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

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

(FOR COURSES INVOLVING THEORY AND PRACTICAL/ ONLY THEORY)

1. Please prepare the **question papers 40 marks** for courses involving Theory and Practical in such a way that the question paper shall contain **Part A (objective type questions)** for 10 marks, **Part B (Short answers for 10 marks)** & **Part C (Essay type answers for 20 marks)** as per the template enclosed.
2. Please prepare the **question papers 50 marks** for courses involving only Theory in such a way that the question paper shall contain **Part A (objective type questions)** for 10 marks, **Part B (Definition / concepts for 10 marks)**, **Part C (Paragraph answers for 10 marks)** and **Part D (Essay type answers for 20 marks)** as per the template enclosed.
3. Please see that questions are set within the course syllabus covering entire syllabus WITH EQUAL DISTRIBUTION FROM ALL THE FIVE UNITS IN EACH PART.
4. Question papers should be computer generated only.
5. **Please provide key answers for objective type questions.** While providing key answers, please mention the question number and the answer.
6. Remuneration of Rs..... (Rupees 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
(FOR COURSES INVOLVING THEORY AND PRACTICAL)**

Time: Two and half hours

Maximum Marks : 40

PART - A

20 x 0.5 = 10

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

Nature of Questions :

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

PART - B

5 x 2 = 10

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

No. of Questions to be answered : 5

Nature of Questions : Short answers

PART - C

5 x 4 = 20

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

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

Nature of Questions : Essay type answers

**PONDICHERRY UNIVERSITY
PUDUCHERRY**

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

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

Time: Three hours

Maximum Marks : 50

PART - A

20 x 0.5 = 10

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

Nature of Questions :

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

PART - B

10 x 1 = 10

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

No. of Questions to be answered : 10

Nature of Questions : Definitions / Concepts

PART - C

5 x 2 = 10

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

No. of Questions to be answered : 5

Nature of Questions : Paragraph answers

PART - D

5 x 4 = 20

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

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

Nature of Questions : Essay type answers

QUESTION PAPER TEMPLATE

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

----- Semester

Agriculture / Horticulture

Course Title

(FOR COURSES INVOLVING THEORY AND PRACTICAL)

Time: Two and half hours

Maximum Marks: 40

PART A (20 x 0.5 = 10 marks)

Answer all questions

1. Choose the correct answer

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

2. State True or False

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

3. Match the following

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

4. Fill in the blanks

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

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

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

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

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

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

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

QUESTION PAPER TEMPLATE

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

..... Semester

Agriculture / Horticulture

Course Title

(FOR COURSES WITH ONLY THEORY)

Time: Three hours

Maximum Marks: 50

PART A (20 x 0.5 = 10 marks)

Answer all questions

1. Choose the correct answer

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

2. State True or False

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

3. Match the following

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

4. Fill in the blanks

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

PART B (10 x 1 = 10 marks)**Answer any TEN questions (Definitions / Concepts)**

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

PART C (5 x 2 = 10 marks)**Answer any FIVE questions (Paragraph answers)**

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

PART C (5 x 4 = 20 marks)**Answer any FIVE questions (Paragraph answers)**

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

Key Answers for OBJECTIVE QUESTIONS

PART - A

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

PONDICHERRY UNIVERSITY
PUDUCHERRY – 605 014

UNDER GRADUATE PROGRAMME
(Agricultural Sciences)
(SEMESTER SYSTEM)

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

01. REGULATIONS

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

02. SHORT TITLE AND COMMENCEMENT

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

03. DEFINITIONS

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

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

04. REGISTRATION OF COURSES

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

ILLUSTRATION

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

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

05 ISSUE OF HALL TICKETS

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

06 DETAILS OF FEES TO BE PAID BY THE STUDENT

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

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

* As fixed by the University from time to time.

B.Sc. (Hons.) AGRICULTURE DEGREE PROGRAMME

DEPARTMENT WISE DISTRIBUTION OF COURSES

DEPARTMENT OF AGRICULTURAL ECONOMICS AND EXTENSION

Sl.No.	Course No.	Course Title	Cr.Hr.	Semester
AGRICULTURAL ECONOMICS				
1	AEC 201	Principles of Agricultural Economics and Farm Management	2+0	IV
2	AEC 301	Agricultural Finance and Cooperation	1+1	VI
		TOTAL	3 + 1 = 4	
AGRICULTURAL EXTENSION				
1	AEX 101	Rural Sociology & Educational Psychology	2+0	I
2	AEX 201	Fundamentals of Extension Education	1+1	III
		TOTAL	3 + 1= 4	
STATISTICS				
1	STA 301	Basic and Applied Agricultural Statistics	2+1	VI
		TOTAL	2 + 1= 3	

DEPARTMENT OF AGRICULTURAL ENTOMOLOGY

Sl.No.	Course No.	Course Title	Cr.Hr.	Semester
1	AEN 101	Fundamentals of Entomology	2+1	II
2	AEN 301	Pest Management in Crops and Stored Grain	2+1	V
		TOTAL	4 + 2 = 6	

DEPARTMENT OF AGRONOMY

Sl.No.	Course No.	Course Title	Cr.Hr.	Semester
AGRONOMY				
1	AGR 101	Fundamentals of Agronomy	2+1	I
2	AGR 201	Principles and Practices of Natural Farming	1+1	III
3	AGR 202	Crop Production Technology – I (<i>Kharif Crops</i>)	1+2	III
4	AGR 203	Water Management	1+1	IV
5	AGR 204	Crop Production Technology –II (<i>Rabi Crops</i>)	1+2	IV
6	AGR 301	Introduction to Agro-meteorology	1+1	V
7	AGR 302	Weed Management	1+1	V
8	AGR 303	Rainfed Agriculture & Watershed Management	1+1	VI
		TOTAL	9 + 10 = 19	
AGRICULTURAL ENGINEERING				
1	AEG 201	Farm Machinery and Power	1+1	IV
2	AEG 301	Renewable Energy in Agriculture and Allied Sector	1+1	VI
		TOTAL	2 + 2= 4	
ANIMAL HUSBANDRY				
1	AMP 101	Livestock and Poultry Management	1+1	II
			1 + 1=2	

DEPARTMENT OF PLANT BREEDING AND GENETICS

Sl.No.	Course No.	Course Title	Cr.Hr.	Semester
GENETICS AND PLANT BREEDING				
1	GPB 201	Principles of Genetics	2+1	III
2	GPB 202	Basics of Plant Breeding	2+1	IV
3	GPB 301	Crop Improvement (<i>Kharif crops</i>) - I	1+1	V
4	GPB 302	Crop Improvement (<i>Rabi crops</i>) - II	1+1	VI
5	GPB 303	Fundamentals of Agricultural Biotechnology	2+1	VI
		TOTAL	8 + 5 =13	
SEED SCIENCE AND TECHNOLOGY				
1	SST 301	Fundamentals of Seed Science & Technology	1+1	VI
		TOTAL	1 + 1= 2	
CROP PHYSIOLOGY				
1	CRP 301	Fundamentals of Crop Physiology	2+1	V
		TOTAL	2 + 1=3	

DEPARTMENT OF PLANT PATHOLOGY

Sl.No.	Course No.	Course Title	Cr.Hr.	Semester
PLANT PATHOLOGY				
1	PAT 101	Fundamentals of Plant Pathology	2+1	II
2	PAT 301	Diseases of Field and Horticultural Crops & their Management	2+1	V
		TOTAL	4 + 2=6	
AGRICULTURAL MICROBIOLOGY				
1	AGM 301	Agricultural Microbiology and Phyto-remediation	1+1	VI
		TOTAL	1+1=2	
NEMATOTOLOGY				
1	ANM 201	Fundamentals of 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 102	Soil Fertility Management	2+1	II
3	SAC 201	Problematic Soils and their Management	1+1	IV
		TOTAL	5+3=8	
BIOCHEMISTRY				
1	BIC 301	Essentials of Plant Biochemistry	2+1	VI
		TOTAL	2 + 1=3	

DEPARTMENT OF HORTICULTURE

Sl.No.	Course No.	Course Title	Cr.Hr.	Semester
HORTICULTURE				
1	HOR 111	Fundamentals of Horticulture	2+1	I
2	HOR 211	Production Technology of Fruit and Plantation Crops	1+1	III
3	HOR 212	Production Technology of Vegetables and Spices	1+1	IV
4	HOR 311	Ornamental Crops, MAPs and Landscaping	1+1	V
		TOTAL	5 + 4= 9	
FORESTRY				
1	FOR 301	Introductory Agro Forestry	1+1	V
		TOTAL	1 + 1=2	

ABILITY ENHANCEMENT, MULTI-DISCIPLINARY AND VALUE-ADDED COURSES

Sl.No.	Course No.	Course Title	Offering discipline	Cr. Hr.	Semester
ABILITY ENHANCEMENT COURSES					
1	NSS 101 / NCC 101	National Service Scheme I / National Cadet Corps I	NSS / NCC units	0+1	I
2	NSS 102 / NCC 102	National Service Scheme II / National Cadet Corps II	NSS / NCC units	0+1	II
3	PED 201	Physical Education, First Aid, Yoga Practices and Meditation	Physical Education	0+2	III
4	ABE 101	Communication Skills	Ag.Extn. & English	1+1	I
5	ABE 102	Personality Development	Ag.Extn & English	1+1	II
		TOTAL		2 + 6=8	
MULTI-DISCIPLINARY COURSES					
1	MDC 101	Farming Based Livelihood Systems	Agron. & Ag. Econ.	2+1	I
2	MDC 201	Entrepreneurship Development and Business Management	Ag. Econ & Ag. Extn..	2+1	III
3	MDC 301	Agricultural Marketing and Trade	Ag. Econ. & Ag. Extn.	2+1	V
		TOTAL		6+3=9	
VALUE ADDED COURSES					
1	VAC 101	Environmental Studies and Disaster Management	Ag. Mic., SAC & Agron.	2+1	II
2	VAC 201	Agricultural Informatics and Artificial Intelligence	Comp. Sci.	2+1	IV
		TOTAL		4+2=6	

LIST OF ELECTIVE COURSES

Sl.No.	Course No.	Course Title	Cr.Hr.	Semester
1	AEC 401	Agri-Business Management	3+1	VII
2	AEN 401	Sericulture	3+1	VII
3	AEX 401	Agricultural Journalism	3+1	VII
4	AGM 401	Bio-pesticides and Bio-fertilizers	3+1	VII
5	AGM 402	Applied Microbiology	3+1	VII
6	AGR 401	System Simulation and Agro-advisory	3+1	VII
7	AGR 402	Climate Resilient Agriculture	3+1	VII
8	AGR 403	Geo-informatics and Remote Sensing, Precision Farming	3+1	VII
9	AGR 404	Principles and Practices of Organic Farming/ Conservation Agriculture	3+1	VII
10	GPB 401	Commercial Plant Breeding	3+1	VII
11	GPB 402	Biotechnology of Crop Improvement	3+1	VII
12	GPB 403	Micro-propagation Technologies	3+1	VII
13	HOR 401	Hi-tech Horticulture	3+1	VII
14	PAT 401	Plant Diseases Detection, Diagnosis and Management	3+1	VII
15	PHT 401	Post-Harvest Technology and Value Addition	3+1	VII
16	SAC 401	Management of Natural Resources	3+1	VII
17	SAC 402	Agrochemicals	3+1	VII
18	SST 401	Commercial Seed Production	3+1	VII

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	VIII
		TOTAL	0 + 20=20	

NON-GRADUAL COURSES

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

SKILL ENHANCEMENT COURSES

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

SEMESTER WISE DISTRIBUTION OF COURSES

SEMESTER I

Sl. No.	Course No.	Course Title	Dept.	Cr. Hr.
1.	AEX 101	Rural Sociology and Educational Psychology	AEX	2+0
2.	AGR 101	Fundamentals of Agronomy	AGR	2+1
3.	HOR 111	Fundamentals of Horticulture	HOR	2+1
4.	SAC 101	Fundamentals of Soil Science	SAC	2+1
5.	ABE 101	Communication Skills	ENG & AEX	1+1
6.	MDC 101	Farming based livelihood systems	AGR & AEC	2+1
7.	NCC101 / NSS101	National Cadet Corps / National Service Scheme	NCC / NSS	0+1
8.	-	Skill Enhancement course 1	-	0+2
9.	-	Skill Enhancement course 2	-	0+2
10	IFC101	Deeksharambh (Induction cum Foundation course) *	Year Coordinator	0+2*
11.	MAT 101	Introductory mathematics (need based) *	MAT	1+0*
TOTAL				11+10=21

*Non-Gradual Courses

SEMESTER II

Sl.No.	Course No.	Course Title	Dept.	Cr.Hr.
1.	AEN 101	Fundamentals of Entomology	AEN	2+1
2.	AMP 101	Livestock and Poultry Management	AH	1+1
3.	PAT 101	Fundamentals of Plant Pathology	PAT	2+1
4.	SAC 102	Soil Fertility Management	SAC	2+1
5.	ABE 102	Personality Development	AEX & ENG	1+1
6.	VAC 101	Environmental Studies and Disaster Management	SAC, AGM & AGR	2+1
7.	NCC102/ NSS102	National Cadet Corps / National Service Scheme	NCC / NSS	0+1
8.	-	Skill Enhancement course 3	-	0+2
9.	-	Skill Enhancement course 4	-	0+2
TOTAL				10+11=21

SEMESTER III

Sl.No.	Course No.	Course Title	Dept.	Cr.Hr.
1.	AEX 201	Fundamentals of Extension Education	AEX	1+1
2.	AGR 201	Principles and Practices of Natural Farming	AGR	1+1
3.	AGR 202	Crop Production Technology-I (<i>Kharif</i> crops)	AGR	1+2
4.	ANM 201	Fundamentals of Nematology	ANM	1+1
5.	GPB 201	Principles of Genetics	PBG	2+1
6.	HOR 211	Production Technology of Fruit and Plantation Crops	HOR	1+1
7.	PED 201	Physical Education, First Aid, Yoga Practices and Meditation	PED	0+2
8.	MDC 201	Entrepreneurship Development and Business Management	AEC & AEX	2+1
9.	-	Skill Enhancement course 5	-	0+2
		TOTAL		9+12=21

SEMESTER IV

Sl.No.	Course No.	Course Title	Dept.	Cr.Hr.
1.	AEC 201	Principles of Agricultural Economics and Farm Management	AEC	2+0
2.	AEG 201	Farm Machinery and Power	AEG	1+1
3.	AGR 203	Water Management	AGR	1+1
4.	AGR 204	Crop Production Technology-II (<i>Rabi</i> Crops)	AGR	1+2
5.	GPB 202	Basics of Plant Breeding	PBG	2+1
6.	HOR 212	Production Technology of Vegetables and Spices	HOR	1+1
7.	SAC 201	Problematic Soils and their management	SAC	1+1
8.	VAC 201	Agricultural Informatics and Artificial Intelligence	COM	2+1
9.	-	Skill Enhancement course 6	-	0+2
		TOTAL		11+10=21

SEMESTER V

Sl.No.	Course No.	Course Title	Dept.	Cr.Hr.
1.	AEN 301	Pest management in Crops and Stored Grains	AEN	2+1
2.	AGR 301	Introduction to Agro-meteorology	AGR	1+1
3.	AGR 302	Weed Management	AGR	1+1
4.	CRP 301	Fundamentals of Crop Physiology	CRP	2+1
5.	FOR 301	Introductory Agro forestry	HOR	1+1
6.	GPB 301	Crop Improvement (kharif crops) - I	PBG	1+1
7.	HOR 311	Ornamental Crops, MAPs and Landscaping	HOR	1+1
8.	PAT 301	Diseases of Field & Horticultural Crops & their Management	PAT	2+1
9.	MDC 301	Agricultural Marketing and Trade	AEC	2+1
10.	PJN 301*	Educational Tour	-	0+2*
TOTAL				13+9=22

*Non-Gradual Course

SEMESTER VI

Sl.No.	Course No.	Course Title	Dept.	Cr.Hr.
1.	AEC 301	Agricultural Finance & Cooperation	AEC	1+1
2.	AEG 301	Renewable energy in Agriculture and Allied Sector	AEG	1+1
3.	AGM 301	Agricultural Microbiology and Phyto-remediation	AGM	1+1
4.	AGR 303	Rainfed agriculture and watershed management	AGR	1+1
5.	BIC 301	Essentials of Plant Biochemistry	SAC	2+1
6.	GPB 302	Crop Improvement (Rabi crops) - II	PBG	1+1
7.	GPB 303	Fundamentals of Agricultural Biotechnology	PBG	2+1
8.	SST 301	Fundamentals of Seed Science & Technology	SST	1+1
9.	STA 301	Basic and Applied Agricultural Statistics	STA	2+1
TOTAL				12+9=21

SEMESTER VII

Sl.No.	Course No.	Course Title	Cr.Hr.
1.	-	5 Elective courses each of 3+1 credit	15 + 5
		TOTAL	15+5=20

SEMESTER VIII

Sl.No.	Course No.	Course Title	Cr.Hr.
1.	RAE 401	Rural Agricultural Work Experience and Agro-industrial Attachment (RAW & AIA)	0 + 20
		TOTAL	0 + 20

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

Sem.	Core Courses (Major and Minor)	Multi-Disciplinary Course (MDC)	Value Added Course (VAC)	Ability Enhancement Course (ABE)	Skill Enhancement Course (SEC)	Internship/ Student READY	Total Credits	Non gradial	Internship	Online course/ MOOC
I	11	3 ⁽³⁾	—	1 ⁽⁴⁾ +2 ⁽⁵⁾	4		21	2 ⁽¹⁾ +1 ⁽²⁾	---	10⁽¹⁵⁾
II	11	---	3 ⁽⁶⁾	1 ⁽⁴⁾ +2 ⁽⁷⁾	4		21		10 ⁽¹³⁾	
III	14	3 ⁽⁸⁾	---	2 ⁽⁹⁾	2		21		---	
IV	16	---	3 ⁽¹⁰⁾	----	2		21		10 ⁽¹⁴⁾	
V	19	3 ⁽¹¹⁾	----	----	----		22	2 ⁽¹²⁾	---	
VI	21	—	---	---	---		21		---	
VII	20	--	--	---	--		20		--	
VIII		--	--	---	--	20	20			
Total	112	9	6	8	12	20	167	5	--	10

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

(2) Mathematics of 1 credit

(3) Farming based Livelihood systems

(4) NCC/NSS

(5) Communication Skills

(6) Environmental Studies and Disaster management

(7) Personality development

(8) Entrepreneurship Development and Business Management

(9) Physical Education, First Aid and Yoga Practices

(10) Agricultural Informatics and Artificial Intelligence

(11) Agricultural Marketing and Trade

(12) Study tour (10-14 days)

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

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

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

Summary of Credit Distributions

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

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

Sl. No.	Course No.	Course Title	Discipline	Cr. Hr.
1.	AEX 101	Rural Sociology and Educational Psychology	AEX	2+0
2.	AGR 101	Fundamentals of Agronomy	AGR	2+1
3.	HOR 111	Fundamentals of Horticulture	HOR	2+1
4.	SAC 101	Fundamentals of Soil Science	SAC	2+1
5.	ABE 101	Communication Skills	AEX & ENG	1+1
6.	MDC 101	Farming based livelihood systems	AGR & AEC	2+1
7.	NCC101 / NSS101	National Cadet Corps I / National Service Scheme I	NCC / NSS	0+1
8.	-	Skill Enhancement Course 1	-	0+2
9.	-	Skill Enhancement Course 2	-	0+2
10	IFC 101	<i>Deeksharambh</i> (Induction cum Foundation course) *	Year Coordinator	0+2*
11.	MAT 101	Introductory Mathematics*	MAT	0+1*
		TOTAL		11+10=21

*Non-Gradual Courses

Course No.	:	AEX 101
Course Title	:	Rural Sociology and Educational Psychology
Credit Hours	:	2+0
Course Category	:	Core Course

Course Learning Rationale / Course Objective (CLR):

The purpose of learning this course is to:

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

Course Learning Outcomes (CLO):

1. Understand the basic concepts related to rural sociology and educational psychology.
2. Assess the forms of social stratification and role of culture, tradition, attributes and social values in rural society
3. Evaluate the role of social institutions and social organizations for the development of society
4. Develop leadership skills
5. Gain expertise on application of educational psychology in Agricultural Extension

THEORY

Unit 1: Rural Sociology, Indian Rural Society, Social Groups, Social Stratification

Sociology and rural sociology: Meaning, definition, scope, importance of rural sociology in Agricultural Extension, and interrelationship between rural sociology and Agricultural Extension. Indian Rural Society: important characteristics, differences and relationship between rural and urban societies. Social Groups: Meaning, definition, classification, factors considered information and organization of groups, motivation in group formation and role of social groups in Agricultural Extension. Social Stratification: Meaning, definition, functions, basis for stratification, forms of social stratification-characteristics and- differences between class and caste system.

Unit 2: Culture, Values, Rural Settlement, Social Institutions and Organisations

Cultural concepts: culture, customs, folkways, mores, taboos, rituals. Traditions: Meaning, definition and their role in Agricultural Extension. Social Values and Attitudes: Meaning, definition, types and role of social values and attitudes in agricultural Extension. Structure of Rural Society and Pattern of Rural settlement. Social Institutions:

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

Unit 3: Social Interaction, Social Control, Social Change

Social Interaction Process: Associative and Dissociative Social Process. Social Networking: Meaning, types and measurement of social networks. Social Control: Meaning, definition, need of social control and means of social control. Social change: Meaning, definition, nature of social change, dimensions of social change and factors of social change. Migration: Definition, types of Migration, Push and Pull factors of Migration, Migration of Rural youth and its consequences of Agricultural Development.

Unit 4: Psychology and Educational Psychology, Intelligence, Personality

Psychology and educational psychology: Meaning, definition, scope, and importance of educational psychology in Agricultural Extension. Basics of Human behaviour. 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.

Unit 5: Sensation, Perception, Attention, Motivation, Teaching-Learning Process

Sensation-meaning, definition, process and characteristics, Perception, Attention, Motivation and their application in Farmers setting. Teaching: Learning process: Meaning and definition of teaching, learning, Cognitive, Affective and Psychomotor domains of Learning. Learning experience and learning situation, elements of learning situation and its characteristics. Principles of learning and their implication of teaching.

Theory - Lecture Schedule

1. Sociology and Rural Sociology- Meaning, definition, scope and importance- Interrelationship between rural sociology and Agricultural Extension
2. Indian Rural Society -Characteristics of Indian rural society- Differences and relationships between rural and urban societies- Rationale of understanding the traits of rural society for Effective Extension work
3. Social Groups -Meaning, definition, and classification of social groups - Factors considered in formation and organization of groups
4. Motivation in group formation- Role of social groups in Agricultural Extension - Commodity groups, Farmer Interest Groups and Farmer Producer Companies
5. Social Stratification -Meaning, definition, and functions- Basis of stratification and forms- Differences between class and caste systems- Understanding Social Stratification with respect to Agricultural Extension work
6. Cultural Concepts in Rural Society- Culture: Meaning and definition- Customs, folkways, mores, taboos, rituals, traditions and belief.
7. Cultural traditions and their relevance to extension- Barriers due to cultural norms- Cases of impact of culture on Agricultural practices and Extension work
8. Social Values- Meaning, definition, and types of social values and attitudes- Role in Agricultural Extension

9. Social Institutions in Rural Society- Meaning, definition, and major institutions (family, religion, education, economy, politics) - Functions and roles in Agricultural Extension
10. Social Organizations-Meaning, definition, and types of organizations - Role in agricultural development (e.g., cooperatives, SHGs, Voluntary organisations and NGOs)
11. Social Interaction Processes: Associate - Cooperation, Coordination Accommodation and Assimilation and their role in Extension work.
12. Social interaction Processes: Dissociative-Competition and Conflict- Factors influencing the processes and their role in Extension work
13. Social networking: Meaning, types, Measurement of social network-nodes, edges, cliques, centrality measures - Closeness and betweenness
14. Social Control- Meaning, definition, need for social control - Means of social control: formal and informal
15. Social Change: Meaning and Dimensions- Definition and nature of social change
16. Factors Influencing Social Change- Technological, cultural, economic, political, and environmental factors- Agricultural Extension as a change agent
- 17. Mid Semester Examination**
18. Migration: Definition, types of Migration, Push and Pull factors of Migration, Migration of Rural youth and its consequences of Agricultural Development
19. Psychology and Educational Psychology- Meaning, definition, and scope and importance of educational psychology in Agricultural Extension
20. Basics of Human Behavior - Definition and characteristics of human behavior
21. Factors influencing behavior: biological, psychological, social- Importance of understanding behavior in Agricultural Extension
22. Intelligence: - Meaning, definitions of intelligence-Gardner's multiple intelligences- Types of Intelligence- Factors affecting Intelligence
23. Personality: Meaning, definition, types of Personality, Factors influencing development of personality
24. Sensation-meaning, definition, process and characteristics
25. Perception- Meaning, definition, Principles and factors affecting perception-Errors in Perception
26. Attention- Meaning and types of attention- Span of Attention- Factors influencing Attention
27. Motivation- Concept-Application of Maslow's Hierarchy of Needs -Types of Motivation -Intrinsic and Extrinsic Motivation- Importance and Techniques of motivating farmers. Attitude – Concept – Factors influencing the development of attitude of farmers
28. Cognitive Domain of Learning- Meaning and components of cognitive processes- Bloom's Taxonomy (Cognitive domain)- Importance for adults learning
29. Affective Domain of Learning -Meaning and importance of emotions, values, attitudes in learning. Psychomotor Domain of Learning -Meaning and relevance in skill-based learning.
30. Teaching Learning Process- Definition of Teaching- Principles of Teaching- Steps in Extension Teaching.

31. Meaning of learning experience- Elements and characteristics of learning situations.
32. Principles of Learning- Reinforcement, transfer of learning, feedback, practice- Application of principles of learning in agricultural extension programmes

Suggested Reading:

1. J.B. Chitambar, Introductory rural Sociology
2. Desai, A.R. (1977). *Rural Sociology in India*. Popular Prakashan.
3. Doshi, S.L., & Jain, P.C. (2002). *Rural Sociology*. Rawat Publications.
4. Srinivas, M.N. (1980). *Social Change in Modern India*. Orient Longman.
5. Dahama, O.P., & Bhatnagar, O.P. (2005). *Education and Communication for Development*. Oxford IBH.
6. Beteille, A. (1965). *Caste, Class, and Power: Changing Patterns of Stratification in a Tanjore Village*. University of California Press
7. Santrock, J.W. (2020) - *Educational Psychology*. McGraw-Hill Education.
8. Mangal, S.K. (2011) - *Educational Psychology*. PHI Learning Pvt. Ltd.
9. Gardner, H. (2011) - *Frames of Mind: The Theory of Multiple Intelligences*. Basic Books.
10. Woolfolk, A. (2016) - *Educational Psychology*. Pearson Education.
11. Skinner, B.F. (1954) - *The Science of Learning and the Art of Teaching*. Harvard University Press.
12. Chauhan, S.S. (2009) - *Advanced Educational Psychology*. Vikas Publishing House.
13. Knowles, M. (2015) - *The Adult Learner: The Definitive Classic in Adult Education and Human Resource Development*. Routledge.
14. Bloom, B.S. (1956) - *Taxonomy of Educational Objectives*. Longman.
15. Krathwohl, D.R. (1964) - *Taxonomy of Educational Objectives: Affective Domain*. Longman.
16. Gibson, J.J. (1950) - *The Perception of the Visual World*. Houghton Mifflin.
17. Dave, R.H. (1975) - *Psychomotor Skills in Education*. University of London Press.
18. Anderson, L.W., & Krathwohl, D. (2001) - *A Taxonomy for Learning, Teaching, and Assessing: A Revision of Bloom's Taxonomy*.

Web Resources:

1. Food and Agriculture Organization (FAO): *Extension and Rural Development*
www.fao.org
2. National Institute of Agricultural Extension Management (MANAGE) Resources.
3. National Digital Library of India (NDLI) - Educational Psychology Resources
4. MIT OpenCourseWare - *Introduction to Educational Psychology*

Course No.	:	AGR 101
Course Title	:	Fundamentals of Agronomy
Credit Hours	:	2+1
Course Category	:	Core Course

Course Learning Rationale / Course Objectives (CLR):

1. To impart the basic and fundamental knowledge of Agronomy
2. To impart basic knowledge on crop production practices

Course Learning Outcome (CLO):

1. Understanding the fundamentals of Agronomy
2. Knowing the basics of environmental conditions for crop production activities.
3. Knowledge on Basics of production techniques of field crops.
4. Understanding the agro-climatic zones of the country and the state

THEORY

Unit 1: Agronomy and Soil

Agronomy and its scope: Definition, meaning and scope of Agronomy; art, science and business of crop production, relation of Agronomy with other disciplines of Agricultural Science, field crops and classification, importance, ecology and ecosystem. Growth and development of crops: Definition, Meaning and factors affecting growth and development. Soil: Definition, composition, Texture vs Structure, major soils of India

Unit 2: Tillage and Sowing

Tillage and tilth: Definition, objectives, types, advantages and disadvantages of tillage including conservation tillage. Seeds and sowing: Definitions of crops, variety and seed. Factors affecting crop stands establishment: good quality seed, proper tillage, time of sowing seed rate, depth and methods of sowing: broadcasting, drilling, dibbling, transplanting etc. Crop density and geometry: plant geometry and planting geometry, its effect on growth, yield. After cultivation: Thinning, gap filling and inter cultural operations.

Unit 3: Crop Nutrition

Crop nutrition: Definition of essential nutrients, criteria of essentiality, functional elements, classification of essential nutrients, forms of plant nutrients absorbed by plants, Combined/ uncombined forms. Manures and fertilizers: sources of nutrients – inorganic (fertilizers), organic (manures) and bio-fertilizers; their classification and characteristics, Time and methods of fertilizer application. Green manure and its role in crop production: Definition, objectives types of green manuring, desirable characteristics, advantages and limitations of green manuring. Integrated Nutrient Management (INM): Meaning, different approaches and advantages of INM. Nutrient use efficiency.

Unit 4: Water and Weed Management

Water management: Water resources of the world, India and the state; Soil Moisture constants: Types of soil water: Gravitational water, capillary water, hygroscopic water, Irrigation: definition, importance and methods. Weeds: Definition, Importance and basics of classification of weeds and their control.

Unit 5: Cropping system

Agroclimatic zones of India and the state, cropping systems: Factors affecting cropping systems, major cropping patterns and systems in the country. Sustainable crop production: Definition, importance and practices, natural resources and conservation; pollution and pollutants, Allelopathy: Meaning and importance in crop production, Harvesting and post-harvest operations

Theory - Lecture Schedule

1. Agronomy and its scope: Definition, meaning and scope of Agronomy;
2. Agronomy – as art, science and business of crop production,
3. Relation of Agronomy with other disciplines of Agricultural Sciences
4. Field crops: classification and importance,
5. Ecology and ecosystem. Growth and development of crops: Definition, Meaning
6. Factors affecting crop growth and development
7. Soil: Definition, composition, Texture vs Structure, Major soils of India
8. Tillage and tilth: Definition and objectives, Types of tillage, advantages and disadvantages of tillage
9. Modern concepts of tillage including conservation tillage.
10. Seeds and sowing: Definitions of crops, variety and seed. Factors affecting crop stands establishment: good quality seed, proper tillage,
11. Time of sowing seed rate, depth and methods of sowing: broadcasting, drilling, dibbling, transplanting etc.
12. Crop density and geometry: plant geometry and planting geometry, its effect on growth, yield.
13. After cultivation: Thinning, gap filling and inter cultural operations.
14. Crop nutrition: Definition of essential nutrients, criteria of essentiality, functional elements, classification of essential nutrients, forms of plant nutrients absorbed by plants, Combined/ uncombined forms.
15. Manures and fertilizers: Sources of nutrients - inorganic (fertilizers), organic (manures) and bio-fertilizers; their classification and characteristics,
16. Time and methods of fertilizer application.
17. **Mid Semester Examination**
18. Green manure- role in crop production: Definition, objectives types of green manuring, desirable characteristics, advantages and limitations of green manuring.
19. Integrated Nutrient Management (INM): Meaning, different approaches and advantages of INM. Nutrient use efficiency.

20. Water management: Water resources of the world, India and the state
21. Soil Moisture constants.
22. Types of soil water: gravitational water, capillary water, hygroscopic water,
23. Irrigation: Definition, importance and methods
24. Weeds: Definition, Importance and Harmful effects of weeds
25. Classification of weeds
26. Methods of weed control.
27. Agroclimatic zones of India and the state
28. Cropping systems and Crop rotation: Meanings, Factors affecting cropping systems,
29. Major cropping patterns and systems in the country.
30. Sustainable crop production: Definition, importance and practices, natural resources and conservation;
31. Pollution and pollutants, Allelopathy: Meaning and importance in crop production
32. Harvesting and post-harvest operations

Practical

A visit to Instructional Crop farm and study on field crops, Basic terminologies and units of measurements in agriculture; Identification of crops, seeds, fertilizers, pesticides, Crops and cropping systems in different Agro-climatic zones of the state, Study of some preparatory tillage implements, Study of inter tillage implements, Practice of ploughing / puddling, Study and practice of inter cultivation in field crops, Numerical exercises on calculation of seed, plant population and fertilizer requirement, Study of yield contributing characters and yield estimation of crops, Identification of weeds in different crops, Seed germination and viability test of seed, Practice on time and method of application of manures and fertilizers.

Practical Schedule

1. A visit to Instructional Crop farm to identify and study field crops.
2. Study of some basic terminologies and units of measurements in Agriculture
3. Identification of crops, seeds, fertilizers and pesticides
4. Crops and cropping systems in different Agro-climatic zones of the state.
5. Study of Primary tillage implements.
6. Study of secondary tillage implements.
7. Study of inter tillage implements.
8. Practice of ploughing / puddling
9. Study and practice of inter cultivation in field crops.
10. Numerical exercises on calculation of plant population and seed rate.
11. Seed germination and viability test of seed.
12. Raising nursery for wet land and garden land crops.
13. Numerical exercises on calculation of fertilizer requirement.
14. Practice on time and method of application of manures and fertilizers.

15. Study of yield contributing characters and yield estimation of crops.
16. Identification of weeds in different crops.
17. **Final Practical Examination**

Suggested Readings:

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. 2008. Principle of Crop Production, Kalyani Publisher, Ludhiana.
4. Reddy Yellamanda T and Shankar Reddy G H. 1995. Principles of Agronomy. Kalyani Publishers, Ludhiana.
5. Sankaran, S. and V.T. Subbiah Mudaliar. 1997. Principles of Agronomy. The Bangalore Printing and Publishing Co. Ltd., Bangalore.
6. Singh, S.S 1998. Principles and Practices of Agronomy. Kalyani Publishers, New Delhi.

Course No.	:	HOR 111
Course Title	:	Fundamentals of Horticulture
Credit Hours	:	2+1
Course Category	:	Core Course

Course Learning Rationale / Course Objective (CLR):

The purpose of learning this course is to:

1. To provide knowledge on different branches of horticulture *viz.*, pomology, olericulture, floriculture and landscaping, spices and medicinal plants
2. To provide knowledge on orchard management, propagation methods, cultural operations and nutrient management of horticultural crops
3. To provide knowledge on different physiological aspects of horticultural crops

Course Learning Outcomes (CLO):

1. Explain the importance, scope, classification of horticulture
2. Describe the different methods of propagation
3. Narrate the orchard establishment and management
4. Learn about the canopy management in fruit crops
5. Study the bio regulators, irrigation and fertilizer application in horticultural crops

THEORY

Unit 1: Introduction to horticulture

Horticulture: Its different branches, importance and scope, Horticulture and botanical classification, soil and climate for horticultural crops.

Unit 2: Plant propagation

Plant propagation: methods and propagation structures, seed dormancy and seed germination, Merits and demerits of sexual and asexual propagation Stock-scion relationship.

Unit 3: Orchard establishment and management

Principles of orchard establishment and management

Unit 4: Canopy management

Principles of orchard establishment, principles and methods of training and pruning of fruit crops, Juvenility and flower bud differentiation, unfruitfulness in horticultural crops, pollination, pollinizers and pollinators, fertilization and parthenocarpy

Unit 5: Bio regulators, irrigation and fertilizer application

Importance of bio regulators in horticultural crops, irrigation and its methods, Fertilizer application in horticultural crops.

Theory - Lecture Schedule

1. Definition and divisions of horticulture
2. Importance and scope of horticulture
3. Botanical and horticultural classification of horticultural crops
4. Soil and climate for horticultural crops
5. Plant propagation methods in horticultural crops
6. Sexual propagation in horticultural crops
7. Seed dormancy- types and mechanisms
8. Seed dormancy- methods of breaking seed dormancy
9. Seed germination - types of seed germination
10. Asexual propagation - cutting and different methods of cutting in horticultural crops
11. Asexual propagation - budding and different methods of budding in horticultural crops
12. Asexual propagation - layering and different methods of layering in horticultural crops
13. Asexual propagation - grafting and different methods of grafting in horticultural crops
14. Merits and demerits of sexual and asexual propagation
15. Propagation of horticultural crops through specialized plant propagules
16. Stock-scion relationship

17. Mid Semester Examination

18. Orchard and its types
19. Principles of orchard establishment
20. Orchard layout and different planting systems and planting of horticultural crops
21. High density planting in orchards
22. Principles and methods of pruning of fruit crops
23. Principles and methods of training of fruit crops
24. Juvenility and flower bud differentiation
25. Unfruitfulness in horticultural crops - causes and remedies
26. Pollination, pollinizers, pollinators and fertilization in fruit crops
27. Parthenocarpy in horticultural crops
28. Importance of bio regulators in horticultural crops
29. Classification and application of bio regulators in horticultural crops
30. Irrigation and its methods in horticultural crops
31. Classification and application of organic manures and bio-fertilizers in horticultural crops
32. Classification and application of inorganic fertilizers in horticultural crops

Practical

Identification and nomenclature of fruit, Layout of an orchard, pit making and system of planting, Nursery raising techniques of fruit crops, Understanding of plant propagation structures, Propagation through seeds and plant parts, Propagation techniques for horticultural crops, Container, potting mixture, potting and repotting, Training and pruning methods on fruit crops, Preparation of fertilizer mixture and application, Preparation and application of PGR, Layout of different irrigation systems, Maturity studies, harvesting, grading, packaging and storage.

Practical Schedule

1. Identification and nomenclature of fruits
2. Identification and brief description of garden tools
3. Layout of an orchard, pit making and system of planting
4. Nursery raising techniques of fruit crops
5. Understanding of plant propagation structures
6. Propagation of horticultural crops through seeds
7. Propagation of horticultural crops through specialized plant parts
8. Propagation techniques for horticultural crops- layering/cutting
9. Propagation techniques for horticultural crops- budding/grafting
10. Container, potting mixture, potting and repotting
11. Practice of training and pruning methods on fruit crops
12. Preparation of fertilizer mixture and application
13. Preparation and application of PGR
14. Layout of different irrigation systems

15. Maturity studies and harvesting of horticultural crops
16. Grading, packaging and storage of horticultural crops
17. **Final Practical Examination**

Suggested Readings:

1. Chadha, K.L. 2019. Handbook of Horticulture (2 Vol., 2nd Rev. Edn.). ICAR.
2. Kumar, N. 2021. Introduction to Horticulture (9th Edn.). MedTech Science Publications.
3. Misra, K.K. and Kumar, R. 2014. Fundamentals of Horticulture. Biotech Books.
4. Peter, K.V. 2009. Basic Horticulture. NIPA.
5. Salunkhe, D.K. and Kadam, S.S. 2013. A Handbook of Fruit Science and Technology. CRC Press.
6. Singh, J. 2020. Basic Horticulture. Kalyani Publications.
7. Singh, N.P. 2005. Basic Concepts of Fruit Science. IBDC.

Course No.	:	SAC 101
Course Title	:	Fundamentals of soil science
Credit Hours	:	2+1
Course Category	:	Core Course

Course learning Rationale/ course (CLR):

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

Course learning outcomes (CLO):

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

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

THEORY

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

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

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

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

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

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

Unit 4: Soil chemical and biological properties

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

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

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

Theory - Lecture Schedule

1. Soil Science- Introduction, importance, branches of soil science, soil definition, pedological and edaphological concepts. Composition of earth crust.
2. Rocks – classification of rocks based on mode of origin and formation – igneous rocks, sedimentary rocks and metamorphic rocks – classification of rocks based on silica content – weatherability of rocks.
3. Minerals – primary, secondary, essential and accessory minerals – primary minerals – quartz, feldspar, micas, pyroxenes, amphiboles and olivines – weatherability of primary minerals. Secondary minerals- non-silicate minerals – P, Ca, Mg, S and micronutrient containing minerals
4. Weathering – types of weathering – physical weathering of rocks – agents of physical weathering and their role - Chemical weathering – solution, hydration, hydrolysis, carbonation, oxidation and reduction, Biological weathering – role of flora and fauna in weathering process.

5. Soil formation – soil forming factors – classification – climate, biosphere, parent material, topography, time and their role in soil formation – catena – definition.
6. Pedogenic processes – basic processes (gains, losses, transformation and translocations) –Fundamental pedogenic processes- eluviation, illuviation, humification, Specific pedogenic processes -calcification, decalcification laterization, podzolisation, gleization, salinization, desalinization, alkalization, dealkalization and pedoturbation.
7. Soil profile – detailed description of a theoretical soil profile – differences between surface soil and sub soil.
8. Soil physical properties – soil texture – definition – various inorganic components in soil and their properties – various textural classes in soil and their properties.
9. Particle size analysis –Stoke's Law – assumptions and limitations – significance of soil texture.
10. Soil structure – classification – types, classes and grades of soil structure – formation of soil structure
11. Factors affecting soil structure, management of soil structure.
12. Density of soil – bulk density and particle density – factors affecting density parameters – importance of bulk density of soil –soil porosity- definition, types of pores, factors affecting porosity and its importance.
13. Soil colour- causes, measurement- munsell colour chart- factors influencing soil colour- significance.
14. Soil consistency – consistence of wet and dry soils – soil crusting – soil plasticity – Atterberg's plastic limits – factors affecting plastic limits – significance of soil consistence.
15. Soil crusting –formation, effect and management. Soil compaction, effect and their management.
16. Soil temperature – sources of heat – heat capacity and conductivity –factors influencing soil temperature – importance of soil temperature on crop growth – management of soil temperature and importance.
17. **Mid semester examination**
18. Soil air – compositions of atmospheric air and soil air – gaseous exchange – influence of soil air on plant growth, soil properties and nutrient availability – ODR, measurement of oxygen diffusion rate – measures to improve soil aeration.
19. Soil water – forces of soil water retention – pF concept – soil moisture characteristic curves – importance of soil water
20. Soil water potential – components of water potentials – soil moisture constants – field capacity, wilting coefficient, hygroscopic water and saturation – available water and methods for determining soil moisture constants – pressure plate and pressure membrane apparatus.
21. Soil water content – soil water movement – Darcy's Law – saturated, unsaturated and vapour flows – infiltration, percolation and permeability – distribution of water in profile in different soils – soil drainage and its importance.

22. Soil reaction, pH, soil acidity and alkalinity, buffering capacity, effect of pH on nutrient availability, EC and their effect on plant growth.
23. Soil colloids – definition – general properties. Secondary silicate clay minerals –classification based on structure - properties of kaolinite, illite, montmorillonite and chlorite – properties – allophones.
24. Origin of charge in organic and inorganic colloids – negative and positive charges – differences between organic and inorganic soil colloids. Adsorption of ions – types of ion exchange - factors affecting ion exchange capacity of soils
25. Cation and anion exchange capacities of soil – base saturation — importance of Cation Exchange Capacity (CEC) of soils – calculation of base exchange capacity and exchangeable acidity.
26. Soil organic matter – composition – compounds in plant residues – organic matter decomposition, mineralization and immobilization– humus – definition. Importance of soil organic matter and humus – significance of C:N ratio in soil fertility.
27. Soil biology – biomass – flora and fauna – their important characteristics – role of beneficial organisms – Nitrogen fixation, denitrification, solubilization of phosphorus and biological control of plant diseases – promotion of plant growth promoting substances –harmful activities of soil organisms.
28. Soil taxonomy – Keys to soil orders, - criteria at each category of Order suborder, great group, subgroup, family and series – nomenclature according to soil taxonomy
29. Soil survey- types, methods and purpose of soil survey
30. Remote Sensing - principles and basic concepts – sensors and platforms – Aerial and satellite remote sensing – Use of aerial and satellite data in soil resource inventory.
31. Soils of India – major characteristics – potentials and limitations - Objectives of soil science research institute in India (NBSS and LUP, ISSS, LTFE and NSSTL)
32. Soil degradation pollution - behaviour of pesticides and inorganic contaminants, prevention and mitigation of soil pollution.

Practical

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

Practical Schedule

1. Soil analytical techniques and concepts. Common laboratory apparatus. Do's and don'ts in a soil chemistry laboratory.

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

Suggested Readings:

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

Web-Resources:

- 1.http://www.sciencedirect.com/science?_ob=ArticleURL&_udi=B6V674C837XPuser=2945072 & coverDate=01/31/2005&_rdoc=1&_fmt=high&_orig
2. <http://202.200.144.17/sykc/hjx/content/ckzl/6/2.pdf>

3. http://www.pedosphere.com/volume01/pdf/Section_01.pdf
4. http://waterquality.montana.edu/docs/homeowners/Septic_Drainfield_Soil_Suitability_Presentations/6_Soil_Texture_and_Structure.pdf
5. http://wfrec.ifas.ufl.edu/landscape_horticulture/PDFdocuments/SoilProp.pdf
6. [http://www.rootsofpeace.org/assets/Soil%20Testing%20Manual%20V6%20\(Feb%208\).pdf](http://www.rootsofpeace.org/assets/Soil%20Testing%20Manual%20V6%20(Feb%208).pdf)
7. <http://www.soils.wisc.edu/courses/SS325/morphology.html>

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

Course Learning Rationale / Course Objective (CLR):

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

Course Learning Outcomes (CLO):

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

THEORY

Unit 1: Communication Process:

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

Unit 2: Communication Types and Models

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

Unit 3: Basic Communication Skills:

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

Unit 4: Listening and Reading Skills:

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

Unit 5: Structural and Functional Grammar:

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

Theory - Lecture Schedule:

1. The magic of effective communication: Definition of communication- Principles-Functions-Information function - Command and instructive function- Influence or persuasive function and Integrative function - Concepts related to communication (Fidelity Noise, Empathy, Homophily, Heterophily, Propaganda, Publicity and Persuasion)
2. Building self-esteem and overcoming fears: Understanding Confidence and Fear Strategies to build self-esteem and overcome fears-Techniques for Building Confidence- (positive self-talk, practice self-care, build positive relationship, learn from mistakes, practice assertiveness etc.,) Techniques for overcoming fears (focus on preparation, gradual exposure to different communication situations, consistent practice, rehearse out loud etc.,).
3. Communication process-Meaning, Concept, nature (dynamic, social, reciprocal and interdependent) and significance- Elements of communication process and barriers of communication.
4. Communication Types: Verbal - Written communication -oral communication- interpersonal and intrapersonal communication -mass communication- Components of Non-Verbal Communication-Proxemics, Haptics, Gestures, Para linguistics, Facial expressions, Chronemics Oculistics, Posture, Appearance and Artifacts.
5. Models of communication – Linear model-Aristotle, Lasswells model, Shanon-Weaver, Berlo, Leagans, Rogers & Shoemaker. Interactive model-Schramm, Westley& Maclean. Transactional model-Dance Helical model.
6. Linguistic and non-linguistic barriers to communication- communication gap- Types of communication gap (Vertical gaps, Horizontal gaps, Internal gaps, External gaps, Knowledge gaps, Delivery gaps, Generation gaps). Miscommunication- concept and disadvantages
7. Listening and Speaking: Definitions: Hearing Vs Listening. Stages of listening process- Types of listening (Active listening, passive listening, appreciative,

critical, Discriminative Listening, Comprehension listening -Selective Listening).

8. Speaking skills (motor perceptive skills and interaction skills) and types (imitative, intensive, responsive, transactional, interpersonal and extensive).
9. **Mid Semester Examination**
10. Reading Skills -Types of reading (Intensive, extensive, selective, loud, silent, skimming, scanning, - Comprehension -Reading comprehension- comprehension skills- Readability index- Guidelines for effective reading.
11. Writing Skills-Graham's Flow Chart on writing- Types - writing skills for easy reading- Points to be considered in technical writing.
12. Precis writing - Rules for making a precis-guidelines - Styles of technical communication: Assertive Style- Aggressive Style- Passive-Aggressive Style- Submissive Style- Manipulative Style- Abstracting and Summarizing.
13. Curriculum vitae/resume writing; Difference between resume and curriculum vitae. Tips for writing Curriculum vitae/resume writing.
14. Innovative methods to enhance vocabulary (reading extensively, playing word game, listening to podcast, use of mnemonics, practice using new words).
15. Analogy questions: (power of reasoning and ability to think concisely and accurately) for writing farm related contents, Sentence structure Modifiers, connecting words and verbals for effective extension literature writing.
16. Phrases and clauses: Use of phrases and clauses for extension communication (Poster, leaflets and folders). Case: subjective case, possessive case; objective case; Correct usage of nouns, pronouns and antecedents, adjectives, adverbs and articles for extension communication (for agricultural columns in dailies and farm magazines).
17. Agreement of verb with the subject: tense, mood, voice in extension communication. Writing effective sentences- Basic sentence faults to be avoided while writing for farmers.

Practical

Listening and note taking; Writing skills: precis writing, summarizing and abstracting; Reading and comprehension (written and oral) of general and technical articles; Micro-presentations and Impromptu Presentations: Feedback on presentations; Stage manners: grooming, body language, voice modulation, speed; Group discussions; Public speaking exercises; vocabulary building exercises; Interview Techniques; organization of events.

Practical Schedule

1. Practicing Listening and note taking methods
2. Practicing Writing Skills- Precis writing
3. Practicing Summarizing and Abstracting
4. Practicing Reading and Comprehension
5. Writing popular and technical articles
6. Practicing micro presentations - I
7. Practicing micro presentations- II
8. Impromptu presentations

9. Analysing the feedback of presentations
10. Stage manners (grooming, body language, voice modulation and speed: Practicing as individual)
11. Stage manners (grooming, body language, voice modulation and speed: Practicing as Groups)
12. Practicing group discussion -I
13. Public speaking Techniques (Practicing)
14. Practising vocabulary building exercise
15. Practice of resume writing and techniques of Interviewing
16. Exercise on organising events
- 17. Final Practical Examination**

Suggested Readings:

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

Course No.	:	MDC 101
Course Title	:	Farming based livelihood systems
Credit Hours	:	2+1
Course Category	:	Multidisciplinary Course

Course Learning Rationale / Course Objectives (CLR)

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

Course Learning Outcome

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

Theory

Unit I: Livelihood systems

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

Unit II: Farming systems

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

Unit III: Livelihood enterprises

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

Unit IV: Livelihood models

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

Unit V: Livelihood programmes

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

Lecture schedule

1. Status of agriculture in India and different states, Income of farmers and rural people in India
2. Livelihood-Definition, concept and livelihood pattern in urban and rural areas
3. Different indicators to study livelihood systems.
4. Different indicators to study livelihood systems
5. Different indicators to study livelihood systems
6. Different indicators to study livelihood systems
7. Agricultural livelihood systems (ALS): Meaning, approaches and framework
8. Definition of farming systems and farming based livelihood systems
9. Prevalent Farming systems in India contributing to livelihood.
10. Types of traditional and modern farming systems.
11. Components of farming system/ farming-based livelihood systems – I
12. Components of farming system/ farming-based livelihood systems – II
13. Components of farming system/ farming-based livelihood systems – III
14. Crops and cropping systems
15. Livestock - Dairy, Piggery, Goatry
16. Livestock - Poultry, Duckery etc.
17. **MID SEMESTER EXAMINATION**
18. Aqua culture, Duck/Poultry cum Fish, Dairy cum Fish, Piggery cum Fish etc
19. Horticultural crops Agro-forestry systems
20. Small-, medium- and large- enterprises including value chains and secondary enterprises as livelihood components for farmers.
21. Factors affecting integration of various enterprises of farming for livelihood.
22. Feasibility of different farming systems for different agro-climatic zones,
23. Feasibility of different farming systems for different agro-climatic zones,
24. Commercial farming-based livelihood models by NABARD, ICAR and other organizations across the country
25. Risk and success factors in farming-based livelihood systems
26. Case studies on different livelihood enterprises associated with the farming
27. Case studies on different livelihood enterprises associated with the farming
28. Case studies on different livelihood enterprises associated with the farming
29. Schemes and programs by Central and State Government
30. Public and Private organizations involved in promotion of farming-based livelihood opportunities
31. Role of farming-based livelihood enterprises in 21st Century in view of circular economy, green economy, climate change, digitalization and changing lifestyle.
32. Role of farming-based livelihood enterprises in 21st Century in view of circular economy, green economy, climate change, digitalization and changing life style

Practical

Survey of farming systems and agricultural based livelihood enterprises - Study of components of important farming based livelihood models/ systems in different agro-climatic zones - Study of production and profitability of crop based, livestock based, processing based and integrated farming based livelihood models - Field visit of innovative farming system models - Visit of Agri-based enterprises and their functional

aspects for integration of production, processing and distribution sectors and Study of agri-enterprises involved in industry and service sectors (Value Chain Models) - Learning about concept of project formulation on farming-based livelihood systems along with cost and profit analysis - Case study of Start-Ups in agri-sectors.

Practical schedule

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

Suggested Readings

1. Ashley, C. and Carney, D. 1999. Sustainable Livelihoods: Lessons from Early Experience; Department for International Development: London, UK; Volume 7. [Google Scholar]
2. Agarwal, A. and Narain, S. 1989. Towards Green Villages: A strategy for Environmentally, Sound and Participatory Rural Development, Center for Science and Environment, New Delhi, India
3. Carloni, A. 2001. Global Farming Systems Study: Challenges and Priorities to 2030 – Regional Analysis: Sub-Saharan Africa, Consultation Document, FAO, Rome, Italy
4. Dixon, J. and A. Gulliver with D. Gibbon. 2001. Farming Systems and Poverty: Improving Farmers' Livelihoods in a Changing World. FAO & World Bank, Rome, Italy & Washington, DC, USA
5. Evenson, R.E. 2000. Agricultural Productivity and Production in Developing Countries'. In FAO, The State of Food and Agriculture, FAO, Rome, Italy

6. Livelihood Improvement of Underprivileged Farming Community: Some Experiences from Vaishali, Samastipur, Darbhanga and Munger Districts of Bihar by B. P. Bhatt, Abhay Kumar, P.K. Thakur, AmitavaDeyUjjwal Kumar, Sanjeev Kumar, B.K. Jha, Lokendra Kumar, K. N. Pathak, A. Hassan, S. K. Singh, K. K. Singh and K. M. Singh ICAR Research Complex for Eastern Region ICAR Parisar, P.O. Bihar Veterinary College, Patna - 800 014, Bihar
7. Panwar et al. 2020. Integrated Farming System models for Agricultural Diversification, Enhanced Income and employment, Indian Council of Agricultural Research, New Delhi.
8. Reddy, S.R. 2016. Farming System and Sustainable Agriculture, Kalyani Publishers, New Delhi.
9. Singh, J.P., et al. 2015. Region Specific Integrated Farming System Models, ICAR-Indian Institute of Farming Systems Research, Modipuram.
10. Walia, S. S. and Walia, U. S. 2020. Farming System and Sustainable Agriculture, Scientific Publishers, Jodhpur, Rajasthan.

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

Course Learning Rationale / Course Objectives (CLR)

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

Course Learning Outcome (CLO)

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

Practical/Awareness activities

- Aims, objectives, organization of NCC and NCC song. DG's cardinals of discipline.
- Drill- aim, general words of command, attention, stands at ease, stand easy and turning.

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

Practical Schedule

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

14. Basics of social service, weaker sections of society and their needs, NGO's and their contribution, contribution of youth towards social welfare and family planning.
15. Structure and function of human body, diet and exercise, hygiene and sanitation. Preventable diseases including AIDS, safe blood donation, first aid, physical and mental health.
16. Adventure activities. Basic principles of ecology, environmental conservation, pollution and its control.

17. Final Practical Examination

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

Syllabus Practical

1. Introduction and Basic Components of NSS
2. Orientation: History, Objectives, Principles, Symbol, Badge; Regular Programs under NSS.
3. Organizational structure of NSS, Code of conduct for NSS volunteers, Points to be considered by NSS Volunteers' awareness about Health.
4. NSS program activities. Concept of regular activities, Special camping, Day camps, Basis of adoption of village/slums, conducting survey, Analysing Guiding financial patterns of scheme, Youth program/schemes of GOI, Coordination with different agencies and maintenance of diary. Understanding youth. Definition, Profile, Categories, Issues and Challenges of youth; and Opportunities for youth who is agent of the social change.
5. Community mobilization. Mapping of community stakeholders, Designing the message as per problems and their culture; Identifying methods of mobilization involving youth-adult partnership. Social harmony and National integration.
6. Indian history and culture, role of youth in nation building, Conflict resolution and peace building. Volunteerism and Shramdaan. Indian tradition of volunteerism, its need, importance, motivation and constraints; Shaman as part of volunteerism.
7. Citizenship, Constitution, and Human rights. Basic features of constitution of India, Fundamental rights and duties, Human rights, Consumer awareness and rights and Right to information. Family and Society. Concept of family, Community (PRIs and other community-based organizations) and Society.

Practical Schedule

1. Introduction to NSS – Historical roots, aims, philosophy, and the guiding motto.
2. Understanding NSS Emblem and Awards – Significance of the badge, symbol, and recognitions.

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

17. Final Practical Examination

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

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

Course Learning Rationale / Course Objective (CLR):

1. To give a broad view and application areas of the subject of study
2. Helping students from different backgrounds for cultural Integration

3. Knowing about the operational framework of academic process in university
4. Instilling life and social skills, leadership qualities, team working spirit
5. Developing social awareness, ethics and values, creativity
6. Helping students to identify the traditional values and indigenous cultures along with diverse potentialities both in indigenous and developed scenario

Activities

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

1. Discussions on operational framework of academic process in college, as well as interactions with Dean, Professor education, Co-ordinator, Warden, Staff advisor and research co-ordinator of the college
2. Creating awareness on the subject of study, and the traditional values and indigenous cultures along with diverse potentialities both in indigenous and developed scenario
3. Familiarizing various Departments of the Institute, and interaction with Heads and faculties of the Department.
4. Interaction with alumni, business leaders, perspective employers, progressive farmers, outstanding achievers in related fields, and people with inspiring life experiences
5. Group activities to identify the strength and weakness of students (with expert advice for their improvement) as well as to create a platform for students to learn from each other's life experiences
6. Field visits to related research fields/ establishments
7. Sessions on personality development (instilling life and social skills, social awareness, ethics and values, team work, leadership, *etc.*) and communication skills

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

Course Learning Rationale / Course Objective (CLR):

The purpose of learning this course is to:

1. To provide preliminary Knowledge of Mathematics for students

Course Learning Outcomes (CLO):

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

THEORY

Unit 1: Algebra

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

Unit 2: Ordinary Differential Calculus

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

Unit 3: Partial Differential Calculus

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

Unit 4: Integral Calculus

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

Unit 5: Mathematical Models

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

Practical Schedule

1. Introduction to Matrix, Differential Calculus - ODE, PDE and Mathematics in Agriculture
2. Simple problems in Arithmetic, Geometric and Harmonic Progressions.
3. Problems in Addition, Subtraction, Multiplication and Transpose of a matrix
4. Problems in determinants and inverse up to 3rd order by adjoint method.
5. Problems in differentiation of x^n , e^x , $\sin x$ & $\cos x$, derivatives of sum, difference.
6. Derivatives of product, quotient of two functions and differentiation of functions of functions.
7. Simple problem based on Logarithmic differentiation and differentiation by substitution method.
8. Application - Growth rate, Average Cost, and Marginal cost, Marginal Cost, Marginal Revenue.
9. Simple Problem - Partial differentiation: Homogeneous function, Euler's theorem.
10. Problems in Maxima and Minima of the functions of the form $y=f(x)$.
11. Problems in Maxima and Minima of the functions of the form $y = f(x_1, x_2)$.
12. Problems in integration of simple functions Definite Integral
13. Problems in product of two functions using integration by parts Integration by substitution method
14. Application - Problems in Area under simple well-known curves
15. Problems in fitting linear models to experimental data.
16. Problems in fitting Quadratic models and Exponential models to experimental data

17. Final Practical Examination

Suggested readings:

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

II SEMESTER

Sl.No.	Course No.	Course Title	Discipline	Cr.Hr.
1.	AEN 101	Fundamentals of Entomology	AEN	2+1
2.	AMP 101	Livestock and Poultry Management	AH	1+1
3.	PAT 101	Fundamentals of Plant Pathology	PAT	2+1
4.	SAC 102	Soil Fertility Management	SAC	2+1
5.	ABE 102	Personality Development	AEX & ENG	1+1
6.	VAC 101	Environmental Studies and Disaster Management	SAC, AGM & AGR	2+1
7.	NCC102/ NSS102	National Cadet Corps II / National Service Scheme II	NCC / NSS	0+1
8.	-	Skill Enhancement Course 3	-	0+2
9.	-	Skill Enhancement Course 4	-	0+2
		TOTAL		10+11=21

Course No	:	AEN 101
Course Title	:	Fundamentals of Entomology
Credit Hours	:	2+1
Course Category	:	Core Course

Course Learning Rationale / Course Objective (CLR):

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

Course Learning Outcomes (CLO):

1. Understand the outline of Entomology and classification of insects in relation to other arthropods
2. Identify the various morphological characters and their importance for classification of insects
3. Explain the major physiological systems of insects and their functions in growth, development and communication
4. Recognize key insect orders characters and understand the economically important insect families

THEORY

Unit 1: History and importance

History of Entomology in India. Major points related to dominance of Insects in Animal kingdom. Classification of phylum Arthropoda up to classes. Relationship of class Insects with other classes of Arthropoda.

Unit 2: Morphology

Structure and functions of insect cuticle and molting. Body segmentation. Structure of head, thorax and abdomen. Structure and modifications of insect antennae, mouth parts, legs, Wing venation, modifications and wing coupling apparatus.

Unit 3: Anatomy and physiology

Structure and functions of digestive, circulatory, excretory, respiratory, nervous, secretory (Endocrine) and reproductive system, in insects. Types of reproduction in insects. Metamorphosis and diapause in insects. Types of larvae and pupae. Major sensory organs.

Unit 4: Insect ecology

Introduction, environment and its components. Effect of abiotic factors and biotic factors. Categories of pests. Surveillance and forecasting.

Unit 5: Insect systematics

Taxonomy – importance, history and development and binomial nomenclature. Definitions of biotype, Sub-species, Species, Genus, Family and Order. Classification of class Insecta up to Orders, basic groups of present day insects with special emphasis to orders and families of Agricultural importance like Orthoptera: Acrididae, Tettigoniidae, Gryllidae, Gryllotalpidae; Dictyoptera: Mantidae, Blattidae; Odonata; Isoptera: Termitidae; Thysanoptera: Thripidae; Hemiptera: Pentatomidae, Coreidae, Cimicidae, Pyrrhocoridae, Lygaeidae, Cicadellidae, Delphacidae, Aphididae, Coccidae, Lophophoridae, Aleurodidae, Pseudococcidae; Neuroptera: Chrysopidae; Lepidoptera: Pieridae, Papilionidae, Noctuidae, Sphingidae, Pyralidae, Gelechiidae, Arctiidae, Saturniidae, Bombycidae; Coleoptera: Coccinellidae, Chrysomelidae, Cerambycidae, Curculionidae, Bruchidae, Scarabaeidae; Hymenoptera: Tenthredinidae, Apidae, Trichogrammatidae, Ichneumonidae, Braconidae, Chalcididae; Diptera: Cecidomyiidae, Tachinidae, Agromyziidae, Culicidae, Muscidae, Tephritidae.

Theory - Lecture schedule

1. History of Entomology in India – classification of phylum arthropoda with classes - 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. Circulatory system in insects - haemocoel and dorsal vessel - circulation of blood - composition of haemolymph - haemocytes and their functions.
10. Excretory system in insects - malpighian tubules - accessory excretory organs and physiology of excretion
11. Respiratory system in insects - structure of trachea - tracheoles - types of respiratory system - types of spiracles - respiration in aquatic and endoparasitic insects.
12. Nervous system in insects - structure of neuron – types of nervous systems.
13. Conduction of nerve impulses - axonic and synaptic transmissions.
14. Exocrine and endocrine glands and their function - effect on metamorphosis and reproduction
15. Male and female reproductive systems in insects – structure and modifications. Spermatogenesis and Oogenesis

16. Types of reproduction - oviparous, viviparous, paedogenesis, polyembryony, ovoviporous and parthenogenesis.

17. Mid Semester Examination

18. Metamorphosis and diapause in insects. Immature stages of insects
19. Structure of sense organs - types of sensilla - photoreceptors; chemoreceptors and mechanoreceptors
20. Definition of insect ecology and introduction to environment and its components
21. Effect of abiotic factors- temp, moist, humidity, RF, light and air on the population of insects
22. Effect of biotic factors- food competition, biotic potential and environmental resistance on the population of insects
23. Categories of pests, ETL, EIL, surveillance and forecasting
24. Taxonomy, importance, history and development of insects.
25. Classification and nomenclature of insects. Definition of biotype, sub species, species, genus, family and order
26. Distinguishing characters of Agricultural important orders and family of Orthoptera: Acrididae, Tettigoniidae, Gryllidae, Gryllotalpidae; Dictyoptera: Mantidae, Blattidae; Odonata
27. Isoptera: Termitidae; Thysanoptera: Thripidae
28. Hemiptera: Pentatomidae, Coreidae, Cimicidae, Pyrrhocoridae, Lygaeidae, Cicadellidae, Delphacidae, Aphididae, Coccidae, Lophophidae, Aleurodidae, Pseudococcidae; Neuroptera: Chrysopidae
29. Lepidoptera: Pieridae, Papilionidae, Noctuidae, Sphingidae, Pyralidae, Gelechiidae, Arctiidae, Saturniidae, Bombycidae
30. Coleoptera: Coccinellidae, Chrysomelidae, Cerambycidae, Curculionidae, Bruchidae, Scarabaeidae
31. Hymenoptera: Tenthredinidae, Apidae. Trichogrammatidae, Ichneumonidae, Braconidae, Chalcididae
32. Diptera: Cecidomyiidae, Tachinidae, Agromyziidae, Culicidae, Muscidae, Tephritidae

Practical

Methods of collection and preservation of insects including immature stages; External features of Grasshopper/Blister beetle; Types of insect antennae, mouthparts and legs; Wing venation, types of wings and wing coupling apparatus. Abdomen and its appendages. Types of insect egg, larvae and pupae; Dissection of digestive system in insects (Grasshopper); Study of characters of orders Odonata, Orthoptera, Dictyoptera, Phasmida, Psocoptera, Dermaptera, Isoptera, Thysanoptera, Hemiptera, Lepidoptera, Neuroptera, Coleoptera, Hymenoptera, Diptera and their families of agricultural importance. Insecticides and their formulations. Pesticide appliances and their maintenance. Sampling techniques for estimation of insect population and damage.

Practical Schedule

1. Collection and preservation of insects including immature stages of insects
2. Observations on external features of grasshopper / blister beetle
3. Types of insect head and antennae
4. Types of mouth parts in insects
5. Types of insect legs and wings, Insect abdomen and its appendages
6. Types of immature stages of insects.
7. Dissection of digestive system in insect (Grasshopper)
8. Study of characters of Orders of Odonata, Dictyoptera (Mantidae, Blattidae) and Orthoptera (Acrididae, Tettigoniidae, Gryllidae, Gryllotalpidae)
9. Study of characters of Orders of Phasmida, Psocoptera, Dermaptera, Isoptera (Termitidae) and Thysanoptera (Thripidae)
10. Study of characters of Orders of Hemiptera (Pentatomidae, Coreidae, Cimicidae, Pyrrhocoridae, Lygaeidae, Cicadellidae, Delphacidae, Aphididae, Coccidae, Lophophidae, Aleurodidae, Pseudococcidae, Tingidae, Diaspididae, Kerridae, Membracidae, Miridae, Cicadidae)
11. Study of characters of Orders of Lepidoptera (Pieridae, Papilionidae, Lycaenidae, Hesperidae, Cochliidae, Noctuidae, Sphingidae, Pyralidae, Gelechiidae, Arctiidae, Nymphalidae, Lymantriidae, Saturniidae, Bombycidae, Plutellidae)
12. Study of characters of Orders of Coleoptera (Coccinellidae, Chrysomelidae, Cerambycidae, Curculionidae, Bruchidae, Scarabaeidae, Apionidae, Melolonthidae, Anobiidae, Bostrychidae, Meloidae, Buprestidae)
13. Study of characters of Orders of Hymenoptera (Tenthredinidae, Apidae, Trichogrammatidae, Ichneumonidae, Braconidae, Chalcididae, Sphecidae, Vespidae, Formicidae, Xylocopidae, Bethyidae, Agaonidae)
14. Study of characters of Orders of Diptera (Cecidomyiidae, Tachinidae, Agromyziidae, Culicidae, Muscidae, Tephritidae, Syrphidae) and Neuroptera (Chrysopidae, Myrmeleontidae, Ascalaphidae)
15. Insecticides and their formulations- Pesticide appliances and their maintenance
16. Sampling techniques for estimation of insect population and damage
- 17. Final Practical Examination**

Suggested Readings:

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. Chapman R.F. 1974. Insect Structure and Function, ELBS publishers, New Delhi.
3. Odum, E. P. and G. W. Barrett. 2017. Fundamentals of Ecology. Cengage India Private Limited. Uttar Pradesh.
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.

Course No.	:	AMP 101
Course Title	:	Livestock And Poultry Management
Credit Hours	:	1+1
Course Category	:	Core Course

Course Learning Rationale / Course Objective (CLR):

The purpose of learning this course is:

1. The course aims to impart knowledge and adequate understanding of the importance of livestock and poultry Industry in the National economy.
2. Provide basic knowledge to the students about scientific livestock and poultry rearing practices.
3. To familiarize with different livestock breeds in relation to various agro climatic zones, enabling to choose appropriate breeds for their utility.
4. To disseminate information on scientific feeding using locally available feed components in order to save the farming expenditure
5. Entrepreneurship development through Livestock / Poultry and Integrated Farming System

Course Learning Outcomes (CLO):

1. Understand the role of livestock and poultry in the national economy and its significance in agriculture.
2. Comprehend the principles of livestock and poultry management, including housing, reproduction, nutrition, and disease control.
3. Develop skills in handling, identification, feeding, and breeding strategies for livestock and poultry.
4. Analyse scientific feeding methods, ration formulation, and efficient utilization of feed resources.
5. Apply practical knowledge in livestock and poultry farm operations, including farm layout planning, record keeping, disease prevention, and economic analysis.

THEORY

Unit 1: Introduction

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

Unit 2: Reproduction in Livestock and Poultry

Reproduction in cattle- Oestrus Cycle- Artificial Insemination- Embryo Transfer Technology - Incubation, hatching and brooding of chicks.

Unit 3: Housing and General Management Practices

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

Unit 4: Nutrition and Feeding Management

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

Unit 5: Health Management and Disease Control

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

Theory - Lecture Schedule

1. Role of livestock in the national economy
2. Common nomenclatures used in livestock and poultry management
3. Important Indian and exotic breeds of cattle, buffalo, sheep, goat, swine, and poultry
4. Various systems of Livestock Production: Extensive, Semi-Intensive, Intensive, Mixed, diversified, specialized and Integrated Farming.
5. Reproduction in cattle – Oestrus cycle
6. Artificial Insemination & Embryo Transfer Technology in cattle
7. Incubation, hatching, and brooding in chicks
8. Housing principles, systems of housing and space requirements for different species of livestock and poultry

9. Mid Semester Examination

10. Management of calves, growing heifers, and milch animals
11. Management of sheep, goat, and swine
12. Management of broilers, growers and layers
13. Digestion in livestock and poultry, proximate principles of feed
14. Nutrients and their functions, classification of feedstuffs
15. Feed ingredients, feed supplements, feed additives & feeding of livestock and poultry
16. Introduction to livestock and poultry diseases
17. Disease prevention and control (including vaccination)

Practical

External parts of cattle, buffalo, sheep, goat, swine and poultry. Handling and restraining of livestock. Identification methods of cattle. Judging of dairy cattle. Culling of livestock and poultry. Planning and layout of housing for different types of livestock. Computation of rations for livestock. Identification of livestock and poultry feed ingredients. Clean milk production, milking methods. Hatchery operations, incubation

and hatching equipment. Management of chicks, growers and layers. Debeaking, dusting and vaccination. Economics of cattle, buffalo, sheep, goat, swine and poultry production, Visit to IDF and IPF to study breeds of livestock and poultry and daily routine farm operations and farm records.

Practical Schedule

1. Study of external parts of cattle, buffalo, sheep, goat, swine, and poultry.
2. Handling and restraining techniques for cattle.
3. Identification methods of farm animals and poultry.
4. Judging of dairy cattle and layer birds.
5. Culling of livestock and poultry.
6. Planning and layout of housing for different types of livestock.
7. Computation of rations for livestock based on nutrient requirements.
8. Identification of livestock and poultry feed ingredients.
9. Clean milk production – hygienic practices and different milking methods.
10. Dehorning and castration of livestock
11. Hatchery operations – incubation and hatching equipment
12. Brooding management of chicks.
13. Debeaking and vaccination in poultry.
14. Economics of cattle, buffalo, sheep and goat production.
15. Economics of Swine and Poultry production
16. Visit to livestock and poultry farms.
17. **Final Practical Examination**

Suggested Readings:

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

Course No.	:	PAT 101
Course Title	:	Fundamentals of Plant Pathology
Credit Hours	:	2+1
Course Category	:	Core Course

Course Learning Rationale / Course Objective (CLR):

The purpose of learning this course is:

1. To understand the general concepts and classification of plant diseases
2. To elaborate the process of disease development
3. To get knowledge of general characteristics of protozoa, chromista, fungi, bacteria, virus, and other microorganisms causing plant diseases
4. To know various plant disease management principles and practices

Course Learning Outcomes (CLO):

1. Acquaint the concepts, classification and types of parasitism of plant diseases
2. Comprehend the role of pathogens in pathogenesis
3. Cognize the general characters, taxonomy and symptoms produced by protozoa, chromista, fungi, bacteria, mollicutes, viruses, viroids, algae and phanerogamic parasites.
4. Understand the epidemiology and fundamental principles and practices of plant disease management for effective disease control.

THEORY

Unit 1: Introduction to Plant Pathology

Importance of plant diseases- Definition –objectives of Plant Pathology-History of Plant Pathology - Causes and classification of plant diseases - Koch's postulates- Types of parasitism- Pathogenesis – Disease cycle - Spread and survival of plant pathogens. General characters of Protozoa, Chromista and Fungi - Reproduction in Protozoa, Chromista and Fungi - Symptoms caused by Protozoa, Chromista and Fungi

Unit 2: General characters and taxonomy of *Protozoa*, *Chromista* and *Fungi*

Taxonomy and classification of *Eukaryotes*- Major characteristic features of Kingdom Protozoa, Chromista and Fungi - Classification of Kingdom – *Protozoa* – General characters and diseases caused by Fungi like *Protozoa* (*Plasmodiophora*; *Spongospora*), Life cycle of *Plasmodiophora* - *Flagellate Protozoa* (*Phytomonas*) - Classification of Kingdom -***Chromista***- General characters and symptoms produced by *Oomycetes* (*Pythium*, *Phytophthora* *Albugo*, *Sclerospora*, *Peronospora*, *Pseudoperonospora*, *Bremia* and *Plasmopara*), Life cycle of *Pythium* and *Plasmopara*- Classification of Kingdom – *Fungi* – General characters and symptoms produced by Phylum *Chytridiomycota* (*Synchytrium*) and *Zygomycota* (*Rhizopus* and *Mucor*)

Unit 3: General characters and taxonomy of *Fungi* - *Ascomycota* and *Basidiomycota*

General characters of Phylum *Ascomycota* -Taxonomic characters and symptoms produced by *Taphrinomycetes* (*Taphrina*), *Dothidiomycetes* (*Capnodium*, *Cercospora*, *Macrophomina*, *Helminthosporium*, *Alternaria* and *Venturia*); *Eurotiomycetes* (*Aspergillus*, *Penicillium*); *Leotiomycetes* (*Erysiphe*, *Uncinula*, *Leveillula* and *Phyllactinia*), Life cycle of Powdery Mildew Fungi; *Sordariomycetes* (*Claviceps*, *Fusarium*, *Verticillium*, *Colletotrichum*, and *Pyricularia*), Life cycle of *Claviceps*. General characters of Phylum *Basidiomycota*- Life cycle of rust fungi – Taxonomic characters and symptoms caused by *Pucciniomycetes* (*Puccinia*, *Uromyces*, *Hemileia*, *Melampsora*, *Phragmidium*), Life cycle of Rust fungi (*Puccinia*); *Ustilaginomycetes* (*Sporisorium*, *Ustilago*, *Tolyposporium*, *Urocystis*); *Exobasidiomycetes* (*Exobasidium* and *Tilletia*); *Agaricomycetes* – Edible and Poisonous mushroom - Taxonomic characters and symptoms caused by *Ganoderma*, *Rhizoctonia* and *Sclerotium*

Unit 4: Bacteria, Viruses, Viroids, Algae and Phanerogamic parasite

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*, Viruses Viroids, Algae and Phanerogamic parasites.

Unit 5: Principles of Plant Disease Management

Role of weather factors in plant disease development– survey and assessment Principles and methods of plant disease management Avoidance - Exclusion - Eradication and Protection – chemical, host plant resistance & biological methods – Integrated disease management.

Theory - Lecture Schedule

1. Plant diseases – Significance and history of Plant Pathology (Prevost, Tillet, Anton de Bary, J. G.Kuhn, Millardet, Woronin, Brefeld, Biffen, E.C. Stakman, E.J. Butler, B.B. Mundkur, J.F. Dastur, K.C. Mehta and T.N. Sadasivan).
2. Causes of Plant diseases – Infectious and non – infectious diseases- Biotic agents- Protozoa, Chromista, Fungi, Bacteria, *Candidatus* Phytoplasma, Fastidious vascular bacteria, *Spiroplasma*, Virus, Viroids, Algae and Phanerogamic parasites.
3. Classification of plant diseases- Koch's Postulate.
4. Types of parasitism –parasite, saprophyte, facultative saprophyte, facultative parasite, obligate parasite, biotrophs, hemibiotrophs, perthotrophs, necrotrophs, and symbiosis.
5. Pathogenesis – Development of disease in plants - Disease cycle- Disease triangle.
6. Spread and survival of plant pathogens.
7. Animate agents- Eukaryotes & Prokaryotes- General characters of Protozoa, Chromista and Fungi- Somatic Characters - Resting structures.
8. Asexual and sexual reproduction in Protozoa, Chromista and Fungi.
9. Symptoms caused by Protozoa, Chromista and Fungi.

10. Taxonomy and classification of *Eukaryotes*- – Key to Kingdom, phylum, Sub-Phyla, Classes, Orders and Families. Major characteristic features of Kingdom Protozoa, Chromista and Fungi.
11. Classification of **Kingdom – Protozoa** –Fungi like Protozoa - General characters - Example genus *Plasmodiophora* and *Spongospora* -Life cycle of *Plasmodiophora* – Important characters and diseases caused by *Flagellate Protozoa* – Example Genus *Phytomonas*.
12. Classification of **Kingdom -Chromista**- General Characters of **Oomycota**- Classification- Important Characters of Class **Oomycetes** -Taxonomic characters and symptoms produced by the Genus *Pythium*, *Phytophthora* *Albugo*, *Sclerospora*, *Peronospora*, *Pseudoperonospora*, *Bremia* and *Plasmopara* - Life cycle of *Pythium* and *Plasmopara*.
13. Classification of **Kingdom – Fungi** – General characters – Important Characters of Phylum **Chytridiomycota** – Taxonomic characters and symptoms produced by *Synchytrium* - General characters of Phylum *Zygomycota* - Taxonomic characters and symptoms produced by *Rhizopus* and *Mucor*.
14. Classification of **Kingdom – Fungi** – General characters of Phylum **Ascomycota**- Classification- Important characters of class **Taphrinomycetes** – Taxonomic characters and symptoms produced by *Taphrina* - Important characters of class **Dothidiomycetes** – Taxonomic characters and symptoms produced by *Capnodium*, *Cercospora*, (*Mycosphaerella*), *Macrophomina*, *Helminthosporium* (*Cochliobolus*), *Alternaria* (*Lewia*) and *Venturia* -Life cycle of *Venturia*.
15. Important characters of class **Eurotiomycetes** –Classification- Taxonomic characters and symptoms produced by *Aspergillus* (*Eurotium*), *Penicillium* (*Talaromyces*) - Important characters of class **Leotiomycetes** – Classification- Taxonomic characters and symptoms produced by *Erysiphe*, *Uncinula*, *Leveillula* and *Phyllactinia* - Life cycle of powdery mildew fungi- Important characters of class **Pezizomycetes** – Taxonomic characters of *Morchella* and *Gyromitra*.
16. Important characters of class **Sordariomycetes** – Classification - Taxonomic characters and symptoms produced by *Claviceps*, *Colletotrichum* (*Glomerella*), *Fusarium* (*Gibberella*), *Chaetomium*, *Verticillium*, *Pestalotia* (*Pestalospaeria*) and *Pyricularia* (*Magnaporthe*) - Life cycle of *Claviceps*.
17. **Mid Semester Examination**
18. Classification of Kingdom – *Fungi* – Classification - General characters of Phylum **Basidiomycota**- Types of mycelia, Basidium, Basidiospores and Basidioma.
19. Important characters of class **Pucciniomycetes** - Classification - General characters and life cycle of rust fungi – Taxonomic characters and symptoms caused by *Puccinia*, *Uromyces*, *Hemileia*, *Melampsora* and *Phragmidium*- Life cycle of *Puccinia*.
20. Important characters of class **Ustilaginomycetes** – Classification- Taxonomic characters and symptoms caused by *Sporisorium*, *Ustilago*, *Tolyposporium*, *Urocystis* - Important characters of class **Exobasidiomycetes** - Taxonomic characters and symptoms caused by *Exobasidium* and *Tilletia*.
21. Important characters of class **Agaricomycetes** – Edible and Poisonous mushroom - Important taxonomic characters of *Agaricus*, *Pleurotus*, *Volvariella*, *Lentinus*

and *Calocybe* - Taxonomic characters and symptoms caused by *Ganoderma*, *Rhizoctonia* (*Thanetophorus*) and *Sclerotium* (*Agroathelium*).

22. Classification and general characters of phytopathogenic bacteria - Mode of entry and symptoms produced by *Xanthomonas*, *Ralstonia*, *Erwinia*, *Pectobacterium*, *Rhizobium* (*Agrobacterium*), *Corynebacterium* (*Clavibacter*) and *Streptomyces*.
23. General characters and symptoms produced by *Candidatus* Phytoplasma, Spiroplasma and Fastidious vascular bacteria.
24. General characters of Virus – Morphology, structure and multiplication of plant virus – Symptoms and transmission of plant viruses.
25. Important characters and symptoms of Viroid (Potato spindle tuber, coconut cadang cadang), Algal (*Cephaleuros*) and Phanerogamic parasites- Abiotic diseases - Difference between biotic and abiotic disease.
26. Epidemiology - Role of weather factors in plant disease development.
27. Disease surveillance and assessment.
28. Principles of crop disease management - Avoidance - Exclusion- plant quarantine – domestic, international and embargo - Phytosanitary certificate.
29. Principles of crop disease management - Eradication - Different methods of eradication of plant diseases.
30. Principles of crop disease management - Protection – chemical methods of protection - Fungicides – ideal characters- formulations and adjuvants - Contact and systemic fungicides – Antibiotics - Phytotoxicity of fungicides.
31. Principles of crop disease management – Immunization - Host plant resistance – Definition – Types of resistance - Structural and biochemical defense in plants. - Resistant varieties
32. Biological methods - Mechanism -Important biocontrol agents (*Trichoderma* spp., *Pseudomonas fluorescens*, *Bacillus subtilis*) – Methods of application - Integrated Disease Management (IDM)

Practical

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

Practical Schedule

1. Study of the microscope and acquaintance with laboratory equipment's.
2. Study of symptoms of protozoan, chromistian and fungal diseases.
3. Study of symptoms of bacterial, phytoplasmal and fastidious vascular bacterial diseases.
4. Study of symptoms of viral, viroid, algal and phanerogamic parasitic diseases.
5. Detection and diagnosis of plant diseases.

6. Survey and assessment of plant diseases.
7. General structures of *Protozoa*, *Chromista* and *Fungi* from the diseased specimen- Preparation of temporary mount and microscopic examination of fungal diseases.
8. Gram staining of bacteria.
9. Preparation of culture media.
10. Isolation of plant pathogens – Fungi and bacteria.
11. Purification of plant pathogens – Fungi and bacteria.
12. Demonstration of Koch's Postulates.
13. Study of various groups of fungicides and preparation of Bordeaux mixture and Bordeaux paste.
14. Methods of application of fungicides and calculation of spray fluid.
15. Pre immunization technique in crop disease management
16. Botanicals in plant disease management
17. **Final Practical Examination**

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

Suggested Readings:

1. Richard Oliver, 2024. Agrios's Plant Pathology. Academic Press, New York.
2. Alexopoulos, C.J., Mims, C.W. and Blackwell, M. 2010 Introductory Mycology. John Wiley and Sons Ltd., N. York.
3. Alice D and Jeyalakshmi C 2018. Plant Pathology. A.E Publications, Coimbatore.
4. Ravichandra, N.C. 2013. Fundamentals of Plant Pathology, PHI Learning Private Limited, New Delhi
5. Dube, H.C. 2009. A textbook of Fungi, Bacteria and Viruses, Vikas Publishing House P. Ltd, New Delhi.
6. Mehrotra, R.S. and Aneja, K.R. 1990. An Introduction to Mycology, Wiley E.Ltd. New Delhi.
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. 1001 pp.
9. Janse J.D 2005 Phytobacteriology- Principles and Practice, CABI Publishing, UK.

Web-resources:

1. www.mycobank.org
2. www.mycology.net
3. www.bspp.org.uk
4. www.ictv.org
5. www.bibo.library.cornell.edu
6. www.apsnet.org

Course No.	:	SAC 102
Course Title	:	Soil Fertility Management
Credit Hours	:	2+1
Course Category	:	Core Course

Course Learning Rationale/ Course objective (CLR):

The purpose of learning this course is:

1. To provide a comprehensive knowledge of soil fertility, plant nutrition, fertilizers, and nutrient management

Course Learning Outcomes (CLO):

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

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

THEORY

Unit 1: Introduction to Soil Fertility and Plant Nutrition

History of soil fertility and plant nutrition. Criteria of essentiality. Forms of nutrients in soil. Role, deficiency and toxicity symptoms of essential plant nutrients, Mechanisms of nutrient transport to plants, factors affecting nutrient availability to plants.

Unit 2: Chemistry of soil nutrients

Chemistry of macro and micronutrients.

Unit 3: Soil fertility evaluation and Manures

Soil fertility evaluation, Soil testing. Critical levels of different nutrients in soil. plant analysis, rapid plant tissue tests. Indicator plants. Introduction and importance of manures and fertilizers. Preparation and properties of major manures (FYM, Compost, Vermicompost, Green manuring, Oilcakes).

Unit 4: Fertilizers and Soil amendments

Chemical fertilizers: classification, composition and properties of major fertilizers, secondary and micronutrient fertilizers, Complex fertilizers. Customised fertilisers, water soluble fertilizers nano fertilizers. Soil amendments, Fertilizer Storage, Fertilizer Control Order.

Unit 5: Fertilizer recommendation, Carbon sequestration and Carbon Trading

Fertilizer recommendation approaches. Integrated nutrient management. Methods of fertilizer recommendations to crops. Factor influencing nutrient use efficiency (NUE), methods of application under rainfed and irrigated conditions. STCR/ RTNM/ IPNS, Carbon sequestration and Carbon Trading.

Theory – Lecture Schedule

1. History of soil fertility and plant nutrition, soil fertility and productivity. Criteria of essentiality. Essential and beneficial plant nutrients.
2. Roles, deficiencies and toxicity symptoms of Nitrogen, Phosphorus and Potassium and their corrective measures.
3. Roles, deficiencies and toxicity symptoms of Calcium, Magnesium, Sulphur and micronutrients.
4. Mechanisms of nutrient transport to plant
5. Factors affecting nutrient availability to plants.
6. Sources, forms, mobility, transformation, fixation, losses and availability of nitrogen in soil
7. Sources, forms, mobility, transformation, fixation, losses and availability of phosphorus in soil
8. Sources, forms, mobility, transformation, fixation, losses and availability of potassium in soil
9. Sources, forms, mobility, transformation, fixation, losses and availability of calcium, magnesium and sulphur in soil
10. Sources, forms, mobility, transformation, fixation, losses and availability of micronutrients in soil
11. Concepts and approaches of soil fertility evaluations- Liebig's Law, Mitscherlich's law, Bray's nutrient mobility concept. Inductive and deductive approaches. Isotopic and crop logging technique.
12. Soil fertility evaluation; Soil testing, critical levels of different nutrients in soil, Plant analysis, rapid plant tissue tests. Indicator plants
13. Introduction and importance of manures and fertilizers.
14. Methods of preparation of bulky organic manures, concentrated organic manures (oil cakes), green manures and green leaf manures.
15. Composting techniques- Aerobic and anaerobic (Bangalore & Coimbatore method), enriched FYM
16. Vermicomposting. Composting of organic wastes - Sugarcane trash and coir waste.
- 17. Mid Semester Examination**
18. Definition and classification of N, P and K fertilizers. N fertilizers- composition and properties of Urea, ammonium sulphate, ammonium nitrate and CAN.
19. Manufacture of urea and ammonium sulphate.
20. P fertilizers- composition and properties of Rock phosphate, bone meal, basic slag, single super phosphate, diammonium phosphate and triple super phosphate
21. Manufacturing of SSP and DAP.

22. K fertilizers- composition and properties of MOP and SOP- manufacturing of MOP and SOP
23. Complex fertilizers- definition, manufacture of ammonium phosphate, nitrophosphate and N,P,K complexes. Micronutrient fertilizers
24. Customised fertilisers, water soluble fertilizers nano fertilizers
25. Fertilizer Storage, Fertilizer Control Order
26. Fertilizer recommendation approaches - IARI method, Critical level approaches, Agronomic approaches, DRIS and STCR.
27. Integrated nutrient management
28. Methods of fertilizer recommendations to crops
29. Factors affecting nutrient use efficiency
30. Methods of application under rainfed and irrigated conditions
31. STCR/RTNM/IPNS
32. Carbon sequestration and Carbon Trading

Practical

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

Practical Schedule

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

Suggested Readings:

1. Soil Fertility and Nutrient Management by S. S. Singh, Kalyani Publishers
2. Soil Fertility and Fertilizers by Samuel L. Tisdale, Werner L. Nelson and James D. Beaton, Macmillan Publishing Company, New York
3. The nature and Properties of Soils by Harry O. Buckman and Nyle C
4. Chopra, S. L., Kanwar, J. S. and Rakshit, A. 2013. Analytical Agricultural Chemistry, Kalyani Publishers Ludhiana.
5. Das, D. K. 2011. Introductory Soil Science (3rd Edition), Kalyani publisher, Ludhiana (India).
6. Gupta, P. K. 2009. Soil, Plant, Water and Fertilizer Analysis (2nd Edition), Agrobios, Jodhpur (India).
7. Indian Society of Soil Science (ISSS) 2002. Fundamentals of Soil Science, IARI, New Delhi.
8. Mariakulandai. A. and T.S. Manickam. Chemistry of manures and fertilizers. Asia publishing house, New Delhi.
9. Mengel, K. and E.A. Kirkby. 1987. Principles of Plant Nutrition, 4th ed. International Potash Institute, Worblaufen-Bern, Switzerland.

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

Course Learning Rationale / Course Objective (CLR):

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

Course Learning Outcomes (CLO):

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

THEORY

Unit 1: Personality & Determinants of personality

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

Unit 2: Individual behavior, Perception and Attribution

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

Unit 3: Learning & organizational behavior

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

Unit 4: Intelligence & its measurements

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

Unit 5: Motivation, Teamwork and group dynamics

Motivation- theories and principles, Teamwork and group dynamics.

Theory – Lecture Schedule

1. Personality- Meaning, Definition, Nature of personality, theories of personality - Biological personality, Psychoanalytic, Humanistic, Trait perspective and Behaviourist theories. Personality types – Sheldon, Galen, Pavlov –Extrovert, Introvert and Ambivert.
2. The humanistic approach - Maslow's self-actualization theory. Shaping of personality - stages of shaping - Freud, Erikson, and Piaget's theories.
3. Determinants of personality - Myers-Briggs Typology Indicator -Locus of control and performance, Type A and Type B Behaviours
4. Personality and organizational behavior: Personality-Importance of inherited and acquired characteristics. Organizational behaviour-Meaning and definition. Personality traits in organizational behaviour -OCEAN- (Openness to experience, conscientiousness, extroversion, agreeableness and neuroticism)
5. Foundations of individual behavior – Motivation, Ability, Role perception, Situational factors (MARS) and factors influencing individual behavior - personal factors, environmental factors and organisational factors.
6. Models of individual behavior – Rational and Emotional Model, Behaviouristic and Humanistic Model, Economic and Self-Actualizing Model and Theory X and Theory Y.

7. Perception – meaning, definition, stages and attributes of perception, Perceptual process, factors affecting perception.
8. Fritz Heider Attribution theory, Jones & Davis Correspondent Inference Theory and case studies on Perception and Attribution
9. **Mid Semester Examination**
10. Learning- Meaning and definition, theories (Classical and Operant Conditioning Theory) and principles of learning – Learning and Organizational Behaviour - Behaviorism, Cognitivism, Connectivism, Constructivism, and Humanism.
11. Learning and training – meaning, definition, Learning vs training. Learning feedback (Focus on learning, Be timely: Be constructive: Encourage action, Provide further help, Focus on learning goals, Provide prompt feedback)
12. Attitude and values - meaning, definition, importance – types of values - Attitude Vs Values
13. Intelligence- meaning, definition, types of Intelligence - Abstract, Concrete and Social Intelligence, theories of intelligence (Spearman's Two factor Theory of Intelligence, Thurstone's Theory of Intelligence and Gardner's Theory of Multiple Intelligences)
14. Measurement of intelligence - Binet Test, Wechsler Scales. Factors influencing intelligence.
15. Intelligence and Organizational behavior - Key aspects of intelligence in organization, emotional intelligence –Pillars of emotional intelligence (self-awareness, self-regulation, motivation, empathy and social skills)
16. Motivation theories - Maslow's needs hierarchy, Alderfer's ERG theory, McClelland's achievement motivation and Herzberg's two-factor theory and principles of motivation.
17. Teamwork and Group dynamics – Meaning, Definition, team building, and group dynamics – Meaning, Definition and key elements of group dynamics (roles, norms, relationships, and communication).

Practical

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

Practical Schedule

1. Exercise on MBTI personality analysis
2. Assessing the Learning Styles through Barsch and Kolb Inventories
3. Exercise on applying Learning Strategies
4. Assessing the Motivational needs in an Organization
5. Exercise on assessing motivation using online tools
6. Assessing individual's interpersonal needs- Firo-B (Fundamental Interpersonal Relations Orientation-Behavior)

7. Exercise on Effective Interpersonal Communication in an organization
8. Exercise on Teamwork
9. Exercise on Team building
10. Exercise on Group Dynamics
11. Exercise on Win-win game
12. Exercise on Conflict Management
13. Assessing the Leadership styles and its significance in Organization
14. Assessing the Emotional Intelligence
15. Case studies on Personality and its influence in Organization
16. Case studies on Organizational Behavior
17. **Final Practical Examination**

Suggested Reading:

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

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

Course Learning Rationale / Course Objectives (CLR):

1. To expose and acquire knowledge on the environment
2. To study the environmental stress effects
3. To gain the state-of-the-art - skill and expertise on management of disasters

Course Learning Outcome (CLO):

1. To understand the environmental stress
2. To understand the disaster effects.
3. To know the effect of environmental stress on disaster management

THEORY**Unit 1: Introduction to Environment - Environmental studies**

Definition, scope and importance – Multidisciplinary nature of environmental studies – Segments of Environment-Spheres of Earth - Lithosphere - Hydrosphere - Atmosphere - Different layers of atmosphere.

Unit 2: Natural Resources

Classification - Forest resources. Water resources. Mineral resources Food resources. Energy resources. Land resources. Soil resources. Ecosystems: Concept of an ecosystem - Structure and function of an ecosystem-Energy flowing the ecosystem. Bio diversity and its conservation: Introduction, definition, types. Bio geographical classification of India. Importance and Value of biodiversity. Biodiversity hotspots. Threats and Conservation of biodiversity.

Unit 3: 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. Light pollution. Solid Waste Management: Classification of solid wastes and management methods, Composting, Incineration, Pyrolysis, Biogas production, Causes, effects and control measures of urban and industrial wastes.

Unit 4: Social Issues and the Environment

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

Unit 5: Disaster management

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

Police and other organizations in disaster management.

Theory - Lecture schedule

1. Introduction to Environment - Environmental studies: Definition, scope and importance – Multidisciplinary nature of environmental studies
2. Segments of Environment-Spheres of Earth - Lithosphere - Hydrosphere - Atmosphere - Different layers of atmosphere.
3. Natural Resources: Classification of Forest, water and mineral resources
4. Natural Resources: Classification of food. energy resources and soil and resources
5. Ecosystems: Concept of an ecosystem - Structure and function of an ecosystem-
6. Energy flow in the ecosystem.
7. Bio diversity and its conservation: Introduction, definition, types.
8. Biogeographical classification of India.
9. Importance and Value of biodiversity; Biodiversity hotspots.
10. Threats and Conservation of biodiversity.
11. Environmental Pollution: Definition, cause and effects
12. Control measures of Air pollution, water pollution, soil pollution.
13. Control measures of Marine pollution, noise pollution, thermal pollution and light pollution.
14. Solid Waste Management: Classification of solid wastes and management methods, Composting, Incineration, Pyrolysis, Biogas production, Causes, effects and control measures of urban and industrial wastes.
15. Social Issues and the Environment: Urban problems related to energy.
16. Water conservation, rain water harvesting, watershed management.
- 17. Mid Semester Examination**
18. Environmental ethics: Issues and possible solutions, climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust.
19. Environment Protection Act. Air (Prevention and Control of Pollution) Act.
20. Water (Prevention and control of Pollution) Act.
21. Wildlife Protection Act. Forest Conservation Act.
22. Human Population and the Environment: Environment and human health: Human Rights, Value Education. Women and Child Welfare. Role of Information Technology in Environment and human health. Disaster management:
23. Disaster definition and Types
24. Natural Disasters - Floods, drought, cyclone,
25. Earthquakes, landslides, avalanches, volcanic eruptions,
26. Heat and cold waves.
27. Man Made Disasters: Nuclear disasters, chemical disasters, biological disasters,
28. Building fire, coalfire, forest fire, oil fire, road accidents, rail accidents, air accidents, sea accidents.

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

Practical

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

Practical Schedule

1. Visit to a local area to document environmental assets river / forest / grassland / hill / mountain.
2. Study of Energy: Biogas production from organic wastes.
3. Visit to wind mill / hydro power / solar power units
4. Biodiversity assessment in farming system.
5. Floral and faunal diversity assessment in polluted and unpolluted 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 – Visit to pond/river/hills.
16. Visit to areas affected by natural disaster.
17. **Final Practical Examination**

Suggested Readings:

1. De, A.K. 2010. Environmental chemistry. Published by New Age International Publishers, New Delhi. ISBN:13-9788122426175.384pp
2. Dhar Chakrabarti, P.G. 2011. Disaster management - India's risk management

- policy frame work sand key challenges. Published by Centre for Social Markets (India), Bangalore.36 pp.
3. Erach Bharucha, Text book for Environmental studies. University Grants Commission, New Delhi
 4. Parthiban, K.T. Vennila, Prasanthrajan, S., Umesh, M. and Kanna, S. 2023. Forest, Environment, Biodiversity and Sustainable development. Narendra Publishing House, New Delhi, India. (In Press).
 5. Prasanthrajan M. and Mahendran, P.P. 2008. A text book on Ecology and Environmental Science. ISBN 81-8321-104-6. Agrotech Publishing Academy, Udaipur - 313 002. First Edition: 2008
 6. Prasanthrajan M. 2018. Objective environmental studies and disaster management. ISBN 9789387893825. Scientific publishers, Jodhpur, India. Pp. 146.
 7. Sharma, P.D. 2009. Ecology and Environment, Rastogi Publications, Meerut, India
 8. Tyler Miller and Scot Spoolman. 2009. Living in the Environment (Concepts, Connections, and Solutions). Brooks/cole, Cengage learning publication, Belmont, USA.

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

Course Learning Rationale / Course Objectives (CLR):

The purpose of learning this course is:

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

Course Learning Outcome (CLO):

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

Practical/Awareness activities:

- Arms Drill-Attention, stand at ease, stand easy. Getting on parade. Dismissing and falling out. Ground/take up arms, examine arms. Shoulder from the order and vice-versa, present from the order and vice-versa. Saluting at the shoulder

at the halt and on the march. Short/ long trail from the order and vice- versa. Guard mounting, guard of honor, Platoon/Coy Drill.

- Characteristics of rifle (.22/.303/SLR), ammunition, fire power, stripping, assembling, care, cleaning, and sight setting. Loading, cocking, and unloading. The lying position and holding.
- Trigger control and firing a shot. Range Procedure and safety precautions. Aiming and alteration of sight. Theory of groups and snap shooting. Firing at moving targets. Miniature range firing. Characteristics of Carbine and LMG.
- Introduction to map, scales, and conventional signs. Topographical forms and technical terms.
- The grid system. Relief, contours, and gradients. Cardinal points and finding north. Types of bearings and use of service protractor. Prismatic compass and its use. Setting a map, finding north and own position. Map to ground and ground to map. Knots and lashings, Camouflage and concealment, Explosives and IEDs.
- Field defenses obstacles, mines and mine lying. Bridging, waterman ship. Field water supplies, tracks and their construction. Judging distance. Description of ground and indication of landmarks. Recognition and description of target. Observation and concealment. Field signals. Section formations. Fire control orders. Fire and movement. Movement with/without arms. Section battle drill. Types of communication, media, latest trends and developments.

Practical Schedule:

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

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

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

Note: As per government guidelines, for getting B and C certificate in NCC, minimum years of requirement is 2 and 3 years along with 1-2 annual camps. The enrolled NCC Cadets are required to participate in NCC activities during their 2nd and 3rd years, as assigned by the ANO/1(P) Naval Unit NCC.

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

Syllabus practical

1. Introduction and Basic Components of NSS
2. Orientation: History, Objectives, Principles, Symbol, Badge; Regular Programs under NSS.
3. Organizational structure of NSS, Code of conduct for NSS volunteers, Points to be considered by NSS Volunteers' awareness about Health.
4. NSS program activities. Concept of regular activities, Special camping, Day camps, Basis of adoption of village/slums, conducting survey, Analysing Guiding financial patterns of scheme, Youth program/schemes of GOI, Coordination with different agencies and maintenance of diary. Understanding youth. Definition, Profile, Categories, Issues and Challenges of youth; and Opportunities for youth who is agent of the social change.
5. Community mobilization. Mapping of community stakeholders, Designing the message as per problems and their culture; Identifying methods of mobilization involving youth-adult partnership. Social harmony and National integration.
6. Indian history and culture, role of youth in nation building, Conflict resolution and peace building. Volunteerism and Shramdaan. Indian tradition of volunteerism, its need, importance, motivation and constraints; Shaman as part of volunteerism.
7. Citizenship, Constitution, and Human rights. Basic features of constitution of India, Fundamental rights and duties, Human rights, Consumer awareness and

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

Practical Schedule

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

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

SECOND YEAR**III SEMESTER**

Sl.No.	Course No.	Course Title	Discipline	Cr.Hr.
1.	AEX 201	Fundamentals of Extension Education	AEX	1+1
2.	AGR 201	Principles and Practices of Natural Farming	AGR	1+1
3.	AGR 202	Crop Production Technology-I (<i>Kharif</i> crops)	AGR	1+2
4.	ANM 201	Fundamentals of Nematology	ANM	1+1
5.	GPB 201	Principles of Genetics	PBG	2+1
6.	HOR 211	Production Technology of Fruit and Plantation Crops	HOR	1+1
7.	PED 201	Physical Education, First Aid, Yoga Practices and Meditation	PED	0+2
8.	MDC 201	Entrepreneurship Development and Business Management	AEC & AEX	2+1
9.	-	Skill Enhancement course 5	-	0+2
		TOTAL		9+12=21

Course No	:	AEX 201
Course Title	:	Fundamentals of Extension Education
Credit Hours	:	1+1
Course Category	:	Core Course

Course Learning Rationale / Course Objective (CLR):

The purpose of learning this course is:

1. To understand the concepts and principles of Extension Education, Various extension, teaching methods and information sources.
2. To acquire knowledge on pre-independence and post-independence extension efforts.
3. To acquire knowledge on various rural development programmes.
4. To acquaint with various extension teaching methods and ICT applications in TOT
5. To understand the diffusion and adoption process of agricultural innovations.

Course Learning Outcomes (CLO):

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

THEORY

Unit 1: Extension education and programme planning

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

Unit 2: Extension systems in India

Extension systems in India: extension efforts in pre-independence era (Sriniketan, Marthandam, Firka Development Scheme, Gurgaon Experiment, etc.) and post-independence era (Etawah Pilot Project, Nilokheri Experiment, etc.); Reorganised Extension System (T&V system) various extension/ agriculture development programs launched by ICAR/ Govt. of India (IADP, IAAP, HYVP, KVK, IVLP, ORP, ND, NATP, NAIP, etc.). Social Justice and poverty alleviation programme: ITDA, IRDP/SGSY/NRLM. Women Development Programme: RMK, MSY etc.

Unit 3: New trends in agriculture extension & Rural Development

New trends in agriculture extension: privatization extension, cyber extension/ e-extension, market-led extension, farmer-led extension, expert systems, etc., Commodity Interest Groups (CIGs), Farmers Producer Group (FPG).

Unit 4: Rural Development & Community Development

Rural Development: concept, meaning, definition; various rural development programs launched by Govt. of India. Community Development: meaning, definition, concept and principles, Philosophy of C.D. Rural Leadership: concept and definition, types of leaders in rural context; Method of identification of Rural Leader. Extension administration: meaning and concept, principles and functions. Monitoring and evaluation: concept and definition, monitoring and evaluation of extension programs; transfer of technology: concept and models, capacity building of extension personnel.

Unit 5: Extension teaching methods & Agricultural Journalism

Meaning, classification, individual, group and mass contact methods, ICT Applications in TOT (New and social media), media mix strategies; Agriculture journalism; diffusion and adoption of innovation: concept and meaning, attributes of innovation, process and stages of adoption, adopter categories.

Theory - Lecture schedule

1. Education: Meaning, definition and Types; Extension Education: meaning, definition, scope and process; objectives and principles of Extension Education
2. Programme planning – definition, meaning, process, principles and steps in programme planning / development.
3. Extension systems in India: Extension efforts in pre-independence era (Sriniketan, Marthandam, Firka Development Scheme, Gurgaon Experiment, etc.) and post-independence era (Etawah Pilot Project, Nilokheri Experiment, etc.)-Reorganised Extension System (T&V system).
4. Various extension/ agriculture development programs launched by ICAR/ Govt. of India (IADP, IAAP, HYVP, KVK, IVLP, ORP, ND, NATP, NAIP, etc.). Social Justice and poverty alleviation programme: ITDA, IRDP/SGSY/NRLM) & Women Development Programme: RMK, MSY etc.
5. New trends in agriculture extension: privatization of extension, cyber extension/ e-extension (Video conferencing, Podcast, e-Velanmai, M-Velanmai app. and multimedia).
6. Market-led extension, farmer-led extension: Meaning, definition and importance in extension; expert systems: meaning, definition and application in agriculture (Expert system apps).
7. Rural Development: concept, meaning, definition; various rural development programs launched by Govt. of India (MGNREGA, RSVY, IAY, SGRY, ITDP and PMGSY).
8. Community Development: meaning, definition, concept and principles, Philosophy of Community development;
9. **Mid Semester Examination**

10. Rural leadership: concept and definition, types of leaders in rural context; Methods of identification of Rural Leader.
11. Extension administration: meaning and concept, principles and functions. Monitoring and evaluation: concept and definition, monitoring and evaluation of extension programs & types of evaluation.
12. Transfer of technology: concept and models (Top-down Model, Feedback Model, Farmer- back to - Farmer Model and REP Interaction model), capacity building of extension personnel: Training, meaning, definition and types of trainings
13. Extension teaching methods: meaning, classification; Individual methods- Farm and Home, Personal letter, Official call, observation and Result demonstration.
14. Group contact methods - Method demonstration, meeting, lecture, debate, workshop, seminar, forum, conference, symposium, panel, brain storming, buzz session, role playing and simulation games.
15. Mass contact methods- Campaign, exhibition, farmers day and field trip; ICT Applications in TOT (New and social media), media mix strategies;
16. Agricultural Journalism (Print media) -definition, principles, importance, ABC of news, types of news.
17. Diffusion and Adoption of innovation – concept and meaning, attributes of innovation, process and stages of adoption, adopter categories.

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 new 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. Visit to State department of Agri / Horti to understand the organizational setup, roles, functions and various schemes
2. Study the organizational set up and functions of DRDA.
3. Visit to NGO and learning from their experience in rural development
4. To study the University Extension system
5. Visit to KVK to study the mandated activities
6. Visit to Community Radio station/ Educational Media Centre to understand the process of programme production
7. Visit to All India Radio Station / TV to study the various activities & programmes.
8. Visit to the News Agency press to study the process

9. Handling and use of AV equipments (smart boards), digital camera and LCD projectors
10. Preparation of extension literature- leaflet, folder, booklet and Pamphlet
11. Preparation of news stories and success stories
12. Presentation skill-microteaching exercise
13. Exercise on practicing group discussion technique and presentation skills
14. Visit a village and understand the socio cultural and agricultural related problems being encountered by the villagers/ farmers
15. Understanding PRA techniques and their application in village development plan
16. Exercise on Script writing for Radio and TV programme
17. **Final Practical Examination**

Suggested Readings:

1. Ahuja, B.N. 1997. Theory and Practice of Journalism, Surjeet Publications, New Delhi.
2. Benor Daniel, Q. James Harrison and Baxter Michael. 1984. Agricultural Extension – The Training and Visit System, A World Bank Publication, Washington, USA.
3. Dahama, O.P and O.P. Bhatnagar. 1985. Education and Communication for Development, Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.
4. Katar Singh. 1999. Rural Development – Principles, Policies and Management, Sage Publications India Pvt. Ltd., New Delhi.
9. Kelsey, L.D and C.C. Hearne. 1967. Cooperative Extension Work, Cornell University Press, New York.
10. Neela Mukherjee. 1993. Participatory Rural Appraisal: Methodology and Applications, Concept Publishing Co.
11. Ray, G.L. 1999. Extension Communication and Management, NayaProkash, 206, BidhanSarani, Calcutta.
12. Reddy Adivi, A. 1993. Extension Education, Shree Lakshmi Press, Bapatla, Andhra Pradesh.
13. Rogers, E.M. 1995. Diffusion of Innovations, The Free Press, New York.
14. Sagar Mondal and Ray, G.L. 2007. Text book of Rural Development, Kalyani Publishers, New Delhi.
15. Sandhu, A.S. 1996. Agricultural Communication: Process and Methods, Oxford & IBH Publishing Co. Pvt. Ltd, New Delhi.
16. Sandhu, A.S. 1996. Extension Programme Planning, Oxford & IBH Publishing Co. Pvt. Ltd, New Delhi.
17. Singh, A.K. 2012. Agricultural Extension, Agrobios, New Delhi.
18. Supe, S.V. 1997. An Introduction to Extension Education, Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.
19. Van den Ban, A.W and H.S. Hawkins. 2002. Agricultural Extension, CBS Publishers & Distributors, New Delhi.

Course No.	:	AGR 201
Course Title	:	Principles and Practices of Natural Farming
Credit Hours	:	1+1
Course Category	:	Core Course

Course Learning Rationale / Course Objective (CLR):

The purpose of learning this course is:

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

Course Learning Outcome (CLO):

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

THEORY

Unit 1: Introduction and History

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

Unit 2: Natural Farming: Concept, Importance and Types

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

Unit 3: Natural farming vs other farming systems

Characteristics and design of a natural farm, Concept of ecological balance, ecological engineering and community responsibility in natural versus other farming systems, Introduction to concept of ecological, water, carbon and nitrogen foot prints, Concept and evaluation of ecosystem services, integration of crops, trees and animals, cropping system approaches, Biodiversity, indigenous seed production, farm waste recycling, water conservation and renewable energy use approaches in a natural farm,

Unit 4: Management practices, certification and standards

Rearing practices for animals under natural farming. Nutrient management in natural farming and their sources, Insect, pest, disease and weed management under natural farming; Mechanization in natural farming, Processing, labelling, economic considerations and viability, certification and standards in natural farming, marketing and export potential of natural farming produce and products.

Unit 5: Initiatives for the promotion of natural farming

Initiatives taken by Government (central/state), NGOs and other organizations for promotion of natural farming and chemical free agriculture, Case studies and success stories in natural farming and chemical free traditional farming, Entrepreneurship opportunities in natural farming.

Theory - Lecture Schedule

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

Practical

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

Practical Schedule

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

Suggested Readings:

1. Ayachit, S.M. 2002. Kashyapi Krishi Sukti (A Treatise on Agriculture by Kashyapa). Brig Sayeed Road, Secunderabad, Telangana: Asian Agri-History Foundation 4: 205.
2. Boeringa, R. (Eed.). 1980. Alternative Methods of Agriculture. Elsevier, Amsterdam, 199 pp.

3. Das, P., Das, S.K., Arya, H.P.S., Reddy, G. Subba, Mishra, A. and others: Inventory of Indigenous Technical Knowledge in Agriculture: Mission mode Project on Collection, Documentation and Validation of Indigenous Technical Knowledge, Document 1 To 7, Indian Council of Agricultural Research, New Delhi.
4. Ecological Farming -The seven principles of a food system that has people at its heart. May 2015, Greenpeace.
5. Ecological Farming, The Seven principles of a food system that has people at its heart. May 2015, Greenpeace
6. FAO. 2018. The 10 elements of agro-ecology: guiding the transition to sustainable food and agricultural system. <https://www.fao.org/3/i9037en/i9037en.pdf> Agro ecosystem Analysis for Research and Development Gordon R. Conway.1985.
7. Fukuoka, M. 1978. The One-Straw Revolution: An Introduction to Natural Farming. Rodale Press, Emmaus, PA. 181 pp.
8. Fukuoka, M. 1985. The Natural Way of Farming: The Theory and Practice of Green Philosophy. Japan Publications, Tokyo, 280 pp.
9. Hill S.B and Ott. P. (Eeds.). 1982. Basic Techniques in Ecological Farming Berkhauser Verlag, Basel, Germany, 366 pp.
10. Hill, S.B. and Ott, P. (Eeds.). 1982. Basic Techniques in Ecological Farming. Berkhauser Verlag, Basel, Germany, 366 pp.
11. HLPE. 2019. Agroecological and other innovative approaches for sustainable agriculture and food systems that enhance food security and nutrition. A report by the High Level Panel of Experts on Food Security and nutrition of the Committee on World Food Security, Rome. <https://fao.org/3/ea5602en/ea5602en.pdf>.
12. INFRC. 1988. Guidelines for Nature Farming Techniques. Atami, Japan. 38 pp.
13. Khurana, A. and Kumar, V. 2020. State of Organic and Natural Farming: Challenges and Possibilities, Centre for Science and Environment, New Delhi.
14. Malhotra R. and S.D. Babaji. 2020. Sanskrit Non-Translatable - The importance of Sanskritizing English. Amaryllis, New Delhi India.
15. Nalini, S. 1996. Vrikshayurveda (The Science of Plant Life) by Surapala. AAHF Classic Bulletin 1. Asian Agri-History Foundation, Brig Sayeed Road, Secunderabad, AP (now Telangana), India. 94pp.
16. Nalini, S. 1999. Krishi-Parashara (Agriculture by Parashara) by Parashara. Brig Sayeed Road, Secunderabad, Telangana: AAHF Classic Bulletin, Asian Agri-History Foundation. 104pp.
17. Nalini, S. 2011. Upavana Vinoda (Woodland Garden for Enjoyment) by Sarangdhara (13th century CE): AAHF Classic Bulletin 8. Asian Agri-History Foundation, Brig Sayeed Road, Secunderabad, AP (now Telangana), India. 64p
18. Natural Asset Farming: Creating Productive and Biodiverse Farms by David B. Lindenmayer, Suzannah M. Macbeth, et al. (2022)
19. Natural Farming Techniques: Farming without tilling by Prathapan Paramu (2021)
20. Plenty for All: Natural Farming A to Z Prayog Pariwar Methodology by Prof. Shripad A. Dabholkar and Prayog Pariwar Prayog Pariwar (2021)
21. Reyes Tirado. 2015. Ecological Farming- The seven principles of a food system that has people at its heart. Greenpeace Research laboratories. University of Exeter, Ottho Heldringstraat.

22. Shamasastri, R. 1915. Kautilya's Arthashastra.
23. The Ultimate Guide to Natural Farming and Sustainable Living: Permaculture for Beginners (Ultimate Guides) by Nicole Faires (2016).
24. U. K. Behera. 2013. A text Book of Farming System. Agrotech Publishing House, Udaipur.

Course No.	:	AGR 202
Course Title	:	Crop Production Technology-I (<i>Kharif</i> Crops)
Credit Hours	:	1+2*
Course Category	:	Core Course

*Practical Crop Production- one (1) credit from practical of the course is allotted for Practical Crop Production of selected *kharif* crops covered under this course.

Course Learning Rationale / Course Objective (CLR):

The purpose of learning this course is:

1. To impart basic and fundamental knowledge on principles and practices of *kharif* crop production.
2. To impart knowledge and skill on scientific crop production and management.

Course Learning Outcomes (CLO):

1. Know the suitable crop production technology of *kharif* crops.
2. Acquire hands-on experience / skills and practical knowledge in the scientific cultivation and management of *kharif* crops.
3. Acquire hands-on experience / skills and practical knowledge in the scientific cultivation and management of selected *kharif* crop under practical crop production.

THEORY

Unit 1: Cereals and Millets

Origin, geographical distribution, economic importance, soil and climatic requirements, varieties, cultural practices and yield of Rice, Maize, Sorghum, Pearl millet, Finger millet and other minor millets.

Unit 2: Pulses

Origin, geographical distribution, economic importance, soil and climatic requirements, varieties, cultural practices and yield of Pigeon pea, Mung bean and Urd bean.

Unit 3: Oilseeds

Origin, geographical distribution, economic importance, soil and climatic requirements, varieties, cultural practices and yield of Groundnut, Soybean, Sesame and Castor.

Unit 4: Fibre crops

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

Unit 5: Forage crops

Origin, geographical distribution, economic importance, soil and climatic requirements, varieties, cultural practices and yield of Fodder Sorghum, Fodder Maize, Fodder Cowpea, Fodder Cluster bean, Guinea grass and Napier grass.

Practical

Rice nursery preparation, transplanting of rice, sowing of soybean, pigeon pea and mung bean, maize, groundnut and cotton, effect of seed size on germination and seedling vigour of *kharif* crops, effect of sowing depth on germination of *kharif* crops, identification of weeds in *kharif* crops, top dressing and foliar feeding of nutrients, study of yield contributing characters and yield calculation of *kharif* crops, study of crop varieties and important agronomic experiments at experiential farm, recording biometric observations, Study of forage experiments, morphological description of *kharif* crops, silage and hay making, visit to research centres of related crops.

*Practical syllabus for *Kharif* Practical Crop Production: (e.g. Rice)

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

- Each student will be allotted a minimum land area of 100 to 200 m² 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 *kharif* crop (Rice / maize / sorghum / pearl millet / finger millet / cotton / groundnut / cotton / sesame/ green gram / black gram etc.).

Theory - Lecture Schedule

1. Importance, area, production and productivity of major *kharif* crops in world, India and Puducherry.
2. Rice – Origin, geographic distribution, economic importance, soil and climatic requirements, important varieties and hybrids.

3. Rice - Systems of rice cultivation, System of Rice Intensification, cultural practices and yield.
4. Maize - Origin, geographical distribution, economic importance, soil and climatic requirements, varieties, cultural practices and yield.
5. Sorghum - Origin, geographic distribution, economic importance, soil and climatic requirement, varieties, cultural practices and yield.
6. Pearl millet and Finger Millet - Origin, geographic distribution, economic importance, soil and climatic requirement, varieties, cultural practices and yield.
7. 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.
8. Pigeon pea – Origin, geographic distribution, economic importance, soil and climatic requirement, varieties, cultural practices and yield.

9. Mid Semester Examination

10. Mung bean and Urd bean – Origin, geographic distribution, economic importance, soil and climatic requirement, varieties, cultural practices and yield.
11. Groundnut - Origin, geographic distribution, economic importance, soil and climatic requirement, varieties, cultural practices and yield.
12. Soyabean - Origin, geographic distribution, economic importance, soil and climatic requirement, varieties, cultural practices and yield.
13. Sesame - Origin, geographic distribution, economic importance, soil and climatic requirement, varieties, cultural practices and yield.
14. Castor - Origin, geographic distribution, economic importance, soil and climatic requirement, varieties, cultural practices and yield.
15. Cotton - Origin, geographic distribution, economic importance, soil and climatic requirement, varieties, cultural practices and yield.
16. Jute - Origin, geographic distribution, economic importance, soil and climatic requirement, varieties, cultural practices and yield.
17. Forage crops - Fodder Sorghum, Fodder Maize, Fodder Cowpea, Fodder Cluster bean, Guinea grass and Napier grass - Origin, geographic distribution, economic importance, soil and climatic requirement, varieties, cultural practices and yield.

Practical Schedule

1. Identification of seeds of *kharif* crops.
2. Nursery area preparation for rice / selected kharif crop cultivation
3. Acquiring skill in different seed treatment techniques for kharif crops.
4. Acquiring skill in seed treatment practices for rice / selected kharif crop
5. Layout and raising of crop cafeteria.
6. Practicing nursery sowing and management for rice / selected kharif crop
7. Acquiring skill in nursery preparation and sowing of kharif crops.
8. Study and practice of main field preparation for selected kharif crop
9. To study the effect seed size and sowing depth on germination of kharif crops
10. Practicing of application of manures and fertilizers for selected kharif crop
11. Acquiring skill in main field preparation, manuring and sowing/transplanting of

kharif crops.

12. Practicing sowing / pulling out of seedling and transplanting of selected kharif crop / exposure to mechanized sowing
13. Calculation of seed rate, plant population per unit area of kharif crops.
14. Acquiring skill in pre-emergence application of herbicides
15. Acquiring skill in after cultivation practices of cereals, millets and pulses.
16. Estimation of plant population and acquiring skill in gap filling and thinning.
17. Acquiring skill in after cultivation practices of oilseeds, fibre and forage.
18. Study of weeds and weed management in selected kharif crop / exposure to mechanized weeder.
19. Observations on growth parameters/morphological description of kharif crops.
20. Observation on nutritional deficiency symptoms and corrective measures
21. Study of yield contributing characters and yield estimation of kharif crops.
22. Recording growth parameters and assessing dry matter production
23. Acquiring skill in harvesting of kharif crops.
24. Study of water management practices for selected kharif crop
25. Preparation of silage and hay.
26. Observation of insect pests and diseases and their management
27. Working out cost and returns of kharif crops.
28. Estimation of yield and yield parameters in selected kharif crop
29. Study of crop varieties and important agronomic experiments at experimental farm.
30. Harvesting, threshing and cleaning of the produce/ exposure to mechanized harvesting and threshing.
31. Visit to nearby Forage farm / Agricultural Research Station / Farmer's field.
32. Working out economics for selected kharif crop.
33. Final practical evaluation for practical crop production
34. **Final Practical Examination**

Suggested Readings:

1. B. Gurarajan, R. Balasubramanian and V. Swaminathan. Recent Strategies on Crop Production. Kalyani Publishers, New Delhi.
2. Chidda Singh.1997. Modern techniques of raising field crops. Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi.
3. Rajendra Prasad. Textbook of Field Crops Production - Commercial Crops. Volume II ICAR Publication.
4. S.R. Reddy. 2009. Agronomy of Field Crops. Kalyani Publishers, New Delhi.
5. S.S. Singh. 2005. Crop Management. Kalyani Publishers, New Delhi.
6. UAS, Bangalore. 2011. Package of Practice. UAS, Bangalore.
7. Subhash Chandra Bose, M. and Balakrishnan, V. 2001. Forage Production. South Asian Publishers, New Delhi.
8. Directorate of Agriculture, Chennai and TNAU, Coimbatore. 2020. Crop Production Guide Agriculture 2020.

Course No	:	ANM 201
Course Title	:	Fundamentals of Nematology
Credit Hours	:	1+1
Course Category	:	Core Course

Course Learning Rationale / Course Objective (CLR):

The purpose of learning this course is:

- To impart knowledge on the basics of nematology like history, economic importance, identification of nematodes, biology, host plant interaction and their management.

Course Learning Outcomes (CLO):

- Students would come to know the importance of nematodes, identification and their management and their role as a precursor of many plant diseases.

THEORY

Unit 1: History & development of nematology, position of nematodes in animal kingdom

Introduction. History of Phyto Nematology in India and at international level. Position of nematodes in animal kingdom. Beneficial nematicides. Economic importance of nematodes-plants, animals.

Unit 2: Morphology & Taxonomy of nematodes

Taxonomy of phyto-nematodes. Nematode definition. General morphology of nematodes: cuticle, sensory organs and muscles. Nematode anatomy-digestive, excretory, nervous and reproductive systems. General biology of nematodes.

Unit 3: Bio-ecology, symptoms, classification and disease complex

Classification of nematodes based on parasitism and temperature. Different types of nematode damage symptoms on various horticultural crops. Nematode disease complex involving bacteria, fungi and viruses. Life cycle of important nematodes: *Meloidogyne*, *Heterodera*, *Globodera*, *Rotylenchulus*, *Tylenchulus*, *Radopholus* and *Pratylenchus*.

Unit 4: Nematode pests of crops

Nematode pests of cereals: rice & wheat. Millets: sorghum & maize. Pulses: redgram, blackgram, greengram & cowpea. Oilseeds: groundnut, castor & gingelly. Fibre crops-cotton. Vegetables: tomato, brinjal, bhendi, cabbage, cauliflower & chilli; tuber crops: potato, carrot, sugar beet, beetroot & yam. Flowers: crossandra, chrysanthemum, jasmine & tuberose. Fruits: banana, citrus, grapevine, papaya & guava. Spices and plantation crops: pepper, betel vine, turmeric, cardamom & coconut.

Unit 5: Nematode management

Principles of nematode management-Legislative, physical methods-soil solarisation, hot water treatment; cultural methods-deep ploughing, fallowing, flooding, crop-rotation, trap crops and anti-nemic plants. Host plant resistance. Biological control-bacteria, PGPR; Fungi-Nematode trapping fungi, egg parasitic fungi, antagonistic fungi and micorrhizal fungi. Chemical control and integrated nematode management.

Theory - Lecture Schedule

1. History of plant nematology-India & at international level. Position of nematodes in animal kingdom.
2. Economic importance of nematodes on plants & animals. Habitat and diversity. Beneficial nematodes.
3. Taxonomy of plant parasitic nematodes: Secernentea & Adenophorea
4. Nematode definition. General morphology and biology of nematodes
5. Anatomy of nematodes-digestive, excretory and nervous systems
6. Anatomy of nematodes-different sensory organs and male, female reproductive systems
7. Classification of plant nematodes based on feeding habits, temperature and different types of damage symptoms.
8. Role of nematodes in disease developments & interaction of plant nematodes with other microorganisms
9. **Mid Semester Examination**
10. Bio-ecology of *Meloidogyne*, *Heterodera*, *Globodera*, *Radopholus*, *Tylenchulus*, *Rotylenchulus* & *Pratylenchus*.
11. Nematode pests of rice, wheat, sorghum, maize, redgram, blackgram, greengram & cowpea
12. Nematode pests of oilseeds, fibre crop.
13. Nematode pests of vegetables, fruits and flower crops.
14. Nematode pests of spices and plantation crops.
15. Nematode management: legislative, cultural, physical
16. Nematode management: chemical, biological & HPR
17. INM

Practical Schedule

1. Collection of soil, plant and root samples.
2. Extraction of soil nematodes by Cobb's sieving, Baermann funnel and modified Baermann funnel techniques.
3. Extraction of soil nematodes by sugar flotation technique
4. Extraction of nematodes from seeds, roots and staining of nematode infested roots
5. Observing morphology of *Hoplolaimus* (Ord: Tylenchida) and *Xiphinema* (Ord: Dorylaimida)
6. Identification of *Meloidogyne*
7. Identification of *Heterodera* and *Globodera*

8. Identification of *Pratylenchus* and *Hirschmanniella*
9. Identification of *Helicotylenchus* and *Tylenchorhynchus*
10. Identification of *Aphelechioidea* and *Tylechulus*
11. Study of life stages of *Meloidogyne*
12. Study of life stages of *Rotylenchulus*
13. Study of life stages of *Radopholus*
14. Nematode damage symptoms in rice: white-tip, rice root nematode and root knot nematode
15. Nematode damage symptoms in banana and citrus
16. Study of nematicides, application methods and calculation of dosages.
17. **Final Practical Examination**

Suggested Readings:

1. Parvatha Reddy, P. 2024. Introductory Plant Nematology, Scientific Publishers, New Delhi. p. 412.
2. William R. Nickle, (Special Edition) 2015. Manual of Agricultural Nematology, CRC Press, New York.
3. Ravichandra, N. G. 2015. Methods and Techniques in Plant Nematology, PHI Learning Private Limited, Delhi. p. 595.
4. Raman, K., Walia and Bajaj, H. K. 2015. Introductory Plant Nematology, IARI, New Delhi. p. 240.
5. Parvatha Reddy, P. 1986. A Treatise on Phyto Nematology, Agricole Publishing Academy, New Delhi. p. 381.

Journal:

Indian Journal of Nematology e resources:

1. <https://www.wur.nl/en/research-results/chair-groups/plant-sciences/laboratory-of-nematology.htm>
2. <https://imanema.ugent.be/>
3. <https://nemedussa.ugent.be/>

Course No	:	GPB 201
Course Title	:	Principles of Genetics
Credit Hours	:	2+1
Course Category	:	Core Course

Course Learning Rationale / Course Objective (CLR):

The purpose of learning this course is to:

1. Understand the structure and function of chromosomes, cell division, and chromosomal aberrations related to heredity and inheritance.

2. Explore Mendelian laws and their modifications, epistasis, multiple alleles, and gene interactions in classical genetics.
3. Apply genetic principles to quantitative traits, linkage, recombination, and gene mapping.
4. Analyse sex determination systems, cytoplasmic inheritance, and their exceptions across species.
5. Describe molecular genetics concepts including DNA structure, replication, gene expression, mutation, and gene regulation.

Course Learning Outcomes (CLO):

Upon successful completion of the course, students will be able to:

1. Explain the cytological basis of heredity and identify different types of chromosomes and chromosomal abnormalities.
2. Solve problems involving Mendelian inheritance, gene interactions, linkage, and recombination.
3. Differentiate types of sex determination mechanisms and cytoplasmic inheritance through relevant examples.
4. Interpret classical experiments in molecular genetics and describe the flow of genetic information from DNA to proteins.
5. Analyze the impact of mutations and gene regulation mechanisms on phenotypic expression and heredity.

THEORY

Unit 1: 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 2: 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 3: 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 4: 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 5: 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; *rII* locus. Benzer experiments, Concept of Cistron, muton and recon. Mutation – characteristics of mutation – micro and macro mutation – *ClB* technique - molecular basis of mutation- Transition and transversion; major physical and chemical mutagens.

Theory – Lecture Schedule

1. Definition of genetics, heredity, inheritance, cytology, cytogenetics; Brief history of developments in genetics and cytogenetics, Ideas of heredity
2. 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. Nonallelic 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. **Mid Semester Examination**
18. 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.
19. Strength of linkage and recombination; Two point and three-point test cross. Double cross over, interference and coincidence; genetic map, physical map.
20. Sex determination: Autosomes and sex chromosomes - chromosomal theory of sex determination - different types – sex determination in human, fowl, butterfly, grasshopper, honey bee, Fumea; Sex determination in plants – *Melandrium*, papaya, maize.
21. Genic balance theory of Bridges – Gynandromorphs

22. Sex linked inheritance – criss cross inheritance – reciprocal difference; holandric genes; sex influenced and sex limited inheritance - Genetic disorders
23. Cytoplasmic inheritance and maternal effects – features of cytoplasmic inheritance, chloroplast, mitochondrial - plastid colour in *Mirabilis jalapa* - cytoplasmic male sterility in maize, kappa particles of paramecium.
24. DNA, the genetic material – Griffith's experiment, experiment of Avery, McCleod and McCarthy.
25. DNA, the genetic material - Confirmation by Hershey and Chase; RNA as genetic material – Frankel, Conrat and Singer experiment.
26. Structure of DNA – Watson and Crick model. Central dogma of life. Proof for semi conservative method of DNA replication; Models of DNA replication.
27. DNA replication: steps involved in DNA replication. Transcription: RNA types - mRNA, tRNA, rRNA.
28. Translation: Steps involved in protein synthesis
29. Regulation of gene expression – Operon model of Jacob and Monod – *Lac* and *Trp* operons.
30. Fine structure of gene; *rII* locus. Benzer experiments, Concept of Cistron, muton and recon.
31. Mutation – characteristics of mutation – micro and macro mutation – *ClB* technique.
32. Molecular basis of mutation- Transition and transversion; major physical and chemical mutagens.

Practical

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 F₂ 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.

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.
9. Duplicate and additive epistasis. Duplicate dominant epistasis, Duplicate recessive epistasis, Dominant and recessive epistasis.
10. Multiple alleles and polygenic inheritance
11. Estimation of linkage with F₂ and test cross data; Coupling and repulsion.
12. Problems on three-point test cross; working out interference, coincidence and drawing genetic maps.
13. Problems in cytoplasmic/ maternal inheritance.
14. Problems in sex linked inheritance in Humans and *Drosophila*.
15. Problems in DNA replication, transcription and translation.
16. Problems in gene regulation/ Mutation.
17. **Final Practical Examination**

Suggested Readings:

1. Gupta P.K., 1997. Cytogenetics. Rastogi Publications, Meerut.
2. Verma, P. S. and V. K. Agarwal. 2007. Genetics. S. Chand and Company Ltd./ New Delhi.
3. Stansfield, W.D.1990. Theory and problems of genetics. Mc-Graw Hill Book Co., New York
4. Phundan Singh. 2014. Elements of Genetics. Kalyani Publishers.
5. Benjamin Lewin. 2005. Genes IX Oxford University Press, Oxford.
6. Russel, P.J. 2000. Fundamentals of genetics. Addition Wesley Longman Publishers, USA
7. Daniel Sundararaj, G. Thulasidas and M. Stephen Dorairaj, 1997. Introduction to Cytogenetic and Plant Breeding. Popular Book Depot, Chennai –15.
8. Strickberger. M.W. 1996. Genetics. Prentice-Hall of India Pvt. Ltd. New Delhi.
9. Singh, B.D. 2004. Fundamentals of Genetics, Kalyani Publishers, Chennai.

Web- References:

1. www.nmsu.edu,
2. www.biology200.gsu.edu

Course No	:	HOR 211
Course Title	:	Production Technology of Fruit and Plantation Crops
Credit Hours	:	1+1
Course Category	:	Core Course

Course Learning Rationale / Course Objective (CLR):

The purpose of learning this course is to:

1. To educate about the different forms of classification of fruit crops.
2. To educate about the origin, area, climate, soil, improved varieties and cultivation practices of fruit and plantation crops.
3. To educate about the physiological disorders of fruit crops, palms and plantation crops.

Course Learning Outcomes (CLO):

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

1. Importance and scope of fruit and plantation crops and their classification.
2. Production technology of fruit crops.
3. Production technology of palms and plantation crops.

THEORY

Unit 1: Introduction

Production status of fruit and plantation crops: 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 2: Crop production techniques of mango, banana, papaya, guava, sapota, citrus, grape

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, harvesting and yield, pests and diseases, value addition: Fruit crops: mango, banana, papaya, guava, sapota, citrus, grape.

Unit 3: Crop production techniques of litchi, pineapple, pomegranate, jackfruit and minor fruits (date, ber, aonla and bael)

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, harvesting and yield, pests and diseases, value addition: Fruit crops: litchi, pineapple, pomegranate, jackfruit and minor fruits (date, ber, aonla and bael).

Unit 4: Crop production techniques 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, value addition. Fruit Crops: apple, pear, peach, strawberry, almond, walnut.

Unit 5: Crop production techniques of Plantation Crops

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

Palms: Coconut, Arecanut, Oil palm Palmyrah.

Plantation crops: Tea, Coffee, Cocoa, Cashew, Rubber.

Theory – 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 requirement– varieties - propagation methods -uses of rootstocks- planting density-systems of planting- high density and ultra -high density planting- cropping systems-after care-training and pruning- top working - water, nutrient and weed management, canopy management – special horticultural practices-plant growth regulation - important disorders – maturity indices and harvest – value addition of Mango.
3. Climate and soil requirement– varieties - propagation methods -uses of rootstocks- planting density-systems of planting- high density and ultra -high density planting- cropping systems-after care-training and pruning- top working - water, nutrient and weed management, canopy management – special horticultural practices-plant growth regulation - important disorders – maturity indices and harvest – value addition of Banana.
4. Climate and soil requirement– varieties - propagation methods -uses of rootstocks- planting density-systems of planting- high density and ultra -high density planting- cropping systems-after care-training and pruning- top working - water, nutrient and weed management, canopy management – special horticultural practices-plant growth regulation - important disorders – maturity indices and harvest – value addition of papaya, guava and sapota.
5. Climate and soil requirement– varieties - propagation methods -uses of rootstocks- planting density-systems of planting- high density and ultra -high density planting- cropping systems-after care-training and pruning- top working - water, nutrient and weed management, canopy management – special horticultural practices-plant growth regulation - important disorders – maturity indices and harvest – value addition of Citrus and pineapple.

6. Climate and soil requirement– varieties - propagation methods -uses of rootstocks- planting density-systems of planting- high density and ultra -high density planting- cropping systems-after care-training and pruning- top working - water, nutrient and weed management, canopy management – special horticultural practices-plant growth regulation - important disorders – maturity indices and harvest – value addition of Grapes.
7. Climate and soil requirement– varieties - propagation methods -uses of rootstocks- planting density-systems of planting- high density and ultra -high density planting- cropping systems-after care-training and pruning- top working - water, nutrient and weed management, canopy management – special horticultural practices-plant growth regulation - important disorders – maturity indices and harvest – value addition of litchi, pomegranate and jackfruit
8. Climate and soil requirement– varieties - propagation methods -uses of rootstocks- planting density-systems of planting- high density and ultra -high density planting- cropping systems-after care-training and pruning- top working - water, nutrient and weed management, canopy management – special horticultural practices-plant growth regulation - important disorders – maturity indices and harvest – value addition of minor fruit: date, ber, aonla and bael.

9. Mid Semester Examination

10. Climate and soil requirement– varieties - propagation methods -uses of rootstocks- planting density-systems of planting- high density and ultra -high density planting- cropping systems-after care-training and pruning- top working - water, nutrient and weed management, canopy management – special horticultural practices-plant growth regulation - important disorders – maturity indices and harvest – value addition of Apple, Pear and Peach.
11. Climate and soil requirement– varieties - propagation methods -uses of rootstocks- planting density-systems of planting- high density and ultra -high density planting- cropping systems-after care-training and pruning- top working - water, nutrient and weed management, canopy management – special horticultural practices-plant growth regulation - important disorders – maturity indices and harvest – value addition of Strawberry, Almond, Walnut.
12. Climate and soil requirements, varieties, propagation, nursery management, planting and planting systems, cropping systems, after care, training and pruning for plantation crops, water, nutrient and weed management, intercropping, multi-tier cropping system, mulching, special horticultural practices, maturity indices, harvest and yield, pests and diseases, processing- value addition of Coconut.
13. Climate and soil requirements, varieties, propagation, nursery management, planting and planting systems, cropping systems, after care, training and pruning for plantation crops, water, nutrient and weed management, intercropping, multi-tier cropping system, mulching, special horticultural practices, maturity indices, harvest and yield, pests and diseases, processing- value addition of Arecanut and Cocoa.
14. Climate and soil requirements, varieties, propagation, nursery management, planting and planting systems, cropping systems, after care, training and pruning for plantation crops, water, nutrient and weed management, intercropping, multi-tier cropping system, mulching, special horticultural practices, maturity indices, harvest and yield, pests and diseases, processing- value addition of Rubber

15. Climate and soil requirements, varieties, propagation, nursery management, planting and planting systems, cropping systems, after care, training and pruning for plantation crops, water, nutrient and weed management, intercropping, multi-tier cropping system, mulching, special horticultural practices, maturity indices, harvest and yield, pests and diseases, processing- value addition of Cashew.
16. Climate and soil requirements, varieties, propagation, nursery management, planting and planting systems, cropping systems, after care, training and pruning for plantation crops, water, nutrient and weed management, intercropping, multi-tier cropping system, mulching, special horticultural practices, maturity indices, harvest and yield, pests and diseases, processing- value addition of Tea, Coffee.
17. Climate and soil requirements, varieties, propagation, nursery management, planting and planting systems, cropping systems, after care, training and pruning for plantation crops, water, nutrient and weed management, intercropping, multi-tier cropping system, mulching, special horticultural practices, maturity indices, harvest and yield, pests and diseases, processing- value addition of Oil palm and Palmyrah.

Practical

Propagation techniques, selection of planting material, varieties, important cultural practices for mango, banana, papaya, guava, sapota, grapes, Citrus (mandarin and acid lime), pomegranate, jackfruit, preparation and application of PGR's for propagation, Micro propagation, protocol for mass multiplication and hardening of fruit crops, Identification and description of varieties, mother palm and seed nut selection, nursery practices, seedling selection, fertilizers application, nutritional disorders, pests and diseases of Coconut, Arecanut and cocoa, Tea and coffee, Rubber and cashew, Visit to commercial orchard and plantation industries.

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. **Final Practical Examination**

Suggested Readings:

1. Bandy, F.A. and Sharma, M.K.2010. Advances in temperate fruit production. Kalyani Publishers, Ludhiana
2. Bose, T.K., S.K. Mitra and D. Sanyal 2001. Fruits: Tropical and Subtropical (2 volumes) Naya Udyog, Calcutta.
3. Chadha, K.L. 2001. Handbook of Horticulture. ICAR, Delhi
4. Chadha, T.R. 2001 Textbook of temperate fruits. ICAR, New Delhi
5. Chattopadhyay, T.K. 2001. A Text Book on Pomology (4 volumes). Kalyani Publishers, Ludhiana.
6. Chattopadhyay. 1998. A textbook on pomology (sub-tropical fruits) vol.III. Published by M/s. Kalyani publishers, Ludhiana, New Delhi, Noida. UP.
7. Kumar, N. 1997. Introduction to Horticulture. Rajalakshmi Publications, Nagercoil, Tamilnadu.
8. Singh, S.P. 2004. Commercial Fruits. Kalyani Publishers, Ludhiana
9. Veeraragavathatham, D., Jawaharlal, M., Jeeva, S., Rabindran, R and Umapathy, G. 2004 (2nd edition). Scientific fruit culture. Published by M/s. Suri associates, Coimbatore- 2.

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

Course Learning Rationale / Course Objective (CLR):

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

Practical

Physical education

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

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

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

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

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

Practical Schedule

1. Training and Coaching - Meaning and Concept; Methods of Training; aerobic and aerobic exercises
2. Calisthenics, weight training, circuit training, interval training, Fartlek training
3. Effects of Exercise on Muscular, Respiratory, Circulatory and Digestive systems
4. Balanced Diet and Nutrition: Effects of Diet on Performance
5. Physiological changes due to ageing and role of regular exercise on ageing process
6. Personality, its dimensions and types
7. Role of sports in personality development
8. Motivation and Achievements in Sports
9. Learning and Theories of learning
10. Adolescent Problems and its Management
11. Posture; Postural Deformities and Exercises for good posture.
12. Yoga: History of Yog, Types of Yog, Introduction to Yog,
13. Asanas (Definition and Importance) Padmasana, Vajrasana, Shashankasana, Pashchimotana, Ushtrasana, Tadasana, Padhasana, Ardha Chandrasana, Bhujangasana, Utanpadasana, Sarvangasana, Parvatasana, Patangasana, Shishupalasana – left leg-right leg, Pawanmuktasana, Halasana, Sarvangasana, Ardha Dhanurasana, Sawasana
14. Suryanamskara Pranayama (Definition and Importance) Omkar, Suryabhedana, Chandrabhedana, Anulom Viloma, Shitali, Shitkari, Bhastrika, Bhramari
15. Meditation (Definition and Importance), Yogic Kriyas (Kapalbhati), Tratak, Jalneti and Tribandh
16. Mudras (Definition and Importance) Gyanmudra, Dhyamudra, Vayumudra, Akashmudra, Pruthvimudra, Shunyamudra, Suryamudra, Varunmudra, Pranmudra, Apanmudra, Vyanmudra, Uddanmudra
17. Mid semester Examination
18. Role of yoga in sports - Teaching of Asanas – demonstration, practice, correction and practice.
19. Need and requirement of first aid.
20. First Aid equipment and upkeep.
21. First aid Techniques and first aid related with Respiratory system.
22. First aid related with Heart, Blood and Circulation.
23. First aid related with Wounds and Injuries.

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

34. Final Practical Examination

Suggested Readings:

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

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

Journals:

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

Course No.	:	MDC 201
Course Title	:	Entrepreneurship Development and Business Management
Credit Hours	:	2+1
Course Category	:	Multi-Disciplinary Course

Course Learning Rationale / Course Objective (CLR):

The purpose of learning this course is to:

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

Course Learning Outcomes (CLO):

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

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

THEORY

Unit 1: Entrepreneur and Entrepreneurial Process

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

Unit 2: Environment Scanning and Financial Institutions

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

Unit 3: Selection of Products and Project Preparation

Selection of the product/services, selection of form of ownership; registration, selection of site, capital sources, acquisition of manufacturing know-how, packaging and

distribution. Planning of an enterprise, project identification, selection, and formulation of project; project report preparation, Enterprise Management.

Unit 4: Production Management and Personal Management

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

Unit 5: Financial Management and Marketing Management

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

Theory - Lecture Schedule

1. Development of entrepreneurship, motivational factors, social factors, environmental factors.
2. Characteristics of entrepreneurs, entrepreneurial attributes/competencies.
3. Concept, need for entrepreneurship development
4. Importance of entrepreneurial development.
5. Evolution of entrepreneurship, objectives of entrepreneurial activities,
6. Types of entrepreneurs, functions of entrepreneurs,
7. Importance of entrepreneurial development, and process of entrepreneurship development.
8. Environment scanning and opportunity identification need for scanning–spotting of opportunity.
9. Scanning of the environment– identification of product/service.
10. Starting a project; factors influencing sensing the opportunities.
11. Infrastructure and support systems- good policies, and schemes for entrepreneurship development.
12. Role of financial institutions, and other agencies in entrepreneurship development.
13. Steps involved in the functioning of an enterprise.
14. Selection of the product/services, selection of form of ownership;
15. Registration, selection of site, capital sources, acquisition of manufacturing know-how, packaging, and distribution.
16. Planning of an enterprise, project identification.
- 17. Mid Semester Examination**
18. Selection, and formulation of project.
19. Project report preparation, Enterprise Management.
20. Production management – product, levels of products, product mix, quality control.
21. Production management – cost of production, production controls,

22. Production management – material management and raw material costing.
23. Production management – inventory management and control.
24. Personal management–manpower planning, labour turnover, wages/salaries.
25. Staffing – Job Analysis, Human Resource Planning Process, Recruitment and Selection
26. Financial management/accounting: funds, fixed capital, and working capital, costing and pricing,
27. Financial management/accounting: long-term planning, and short-term planning.
28. Financial management/accounting: bookkeeping, journal, ledger, subsidiary books, annual financial statement.
29. Financial management/accounting: taxation.
30. Marketing management- market, types, marketing assistance, market strategies.
31. Marketing mix and Market segmentation
32. Crisis management- raw material, production, leadership, market, finance, natural etc.

Practical

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

Practical Schedule

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

Suggested Readings:

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

IV SEMESTER

Sl.No.	Course No.	Course Title	Discipline	Cr.Hr.
1.	AEC 201	Principles of Agricultural Economics and Farm Management	AEC	2+0
2.	AEG 201	Farm Machinery and Power	AEG	1+1
3.	AGR 203	Water Management	AGR	1+1
4.	AGR 204	Crop Production Technology-II (<i>Rabi</i> Crops)	AGR	1+2
5.	GPB 202	Basics of Plant Breeding	PBG	2+1
6.	HOR 212	Production Technology of Vegetables and Spices	HOR	1+1
7.	SAC 201	Problematic Soils and their management	SAC	1+1
8.	VAC 201	Agricultural Informatics and Artificial Intelligence	COM	2+1
9.	-	Skill Enhancement course 6	-	0+2
		TOTAL		11+10=21

Course No.	:	AEC 201
Course Title	:	Principles of Agricultural Economics and Farm Management
Credit Hours	:	2+0
Course Category	:	Core Course

Couse Learning Rationale/ Course Objective (CLR):

The purpose of learning this course is:

1. To study concepts of Economics
2. To gain knowledge on agricultural economics and its importance
3. To understand the national income and economy
4. To develop the comprehensive idea about the farm management and its importance in agriculture
5. To study the Optimization of scarce resources

Couse Learning Outcomes (CLO):

1. Understand the demand and supply of the commodities
2. Improved Understanding of exchange and distribution
3. Economy functioning and flow
4. Sustainable Resource Management
5. Efficient utilization of scarce resources

THEORY

Unit 1: Introduction and Concepts of Economics

Economics: Meaning, scope and subject matter, definitions, activities, approaches to economic analysis, micro and macroeconomics, positive and normative analysis; 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, National Institute of Agricultural Economics and Policy Research (ICAR-NIAP).

Unit 2: Demand analysis, Exchange and Distribution

Demand: meaning, law of demand, schedule and demand curve, determinants, utility theory, Demand analysis, consumer's equilibrium, consumer surplus; Elasticity of demand, Production: definition, process, factors of production and input output relationship; laws of returns, Cost: concepts, short run and long run cost curves; Supply v/s stock, law of supply, schedule, supply curve, determinants of supply and elasticity of supply. Market structure: Distribution theory: meaning, factor market and pricing of factors of production; concepts of rent, wage, interest and profit.

Unit 3: National Income and economy

National income: accounting and measurement, difficulties in measurement; Importance of Malthusian and Optimum population theories, Money, Monetary vs barter system of exchange and its problems, evolution, meaning and functions of money, classification of money, general price index; Inflation and control measures; Banking system in India, Budgeting and taxation, Types or system of economy.

Unit 4: Farm Management: Factor – Product, Factor–Factor and Product – Product Relationships

Farm management - concepts, objectives and relationship with other sciences. 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. Factor-Product relationship. Economies of Scale – Economies of Size - Determination of Optimum Input and Output – Physical and Economic Optimum. Factor – Factor relationship, Product – Product relationship: Principle of Equi – Marginal Returns, Principle of Opportunity Cost and Minimum Loss Principle. Comparative advantage.

Unit 5: Farm Planning, Budgeting, Risk and Uncertainty and Resource Economics

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. Farm planning and budgeting its importance, partial and complete budgeting, steps in farm planning, 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. Resource Economics: Concepts, Classification, differences between Natural Resource Economics (NRE) and properties of natural resources (NR) - Issues – Scarcity of resources – Factors mitigating scarcity – Property Rights: Common Property Resources (CPRs): meaning and characteristics of CPRs – Externalities: meaning and types, Inefficiency and welfare loss, solutions; Important issues in economics and management of common property resources of land, water, pasture and forest resources.

Theory - Lecture Schedule

1. Economics meaning and scope, Approaches of Economics
2. Macro and Micro Economics, Critics in Economics
3. Positive and normative Science, Art, Science and Social science
4. Goods and services, Wealth and welfare
5. Agricultural economics, Scope of Agricultural Economics
6. ICAR-NIAP, FAO – Food and Agriculture Organization
7. Demand and demand schedule Types of Demand
8. Elasticity of demand, Consumer surplus
9. Production and Production function, Law of returns
10. Cost concepts, Short run and long run costs
11. Supply and elasticity of supply, Producer surplus and consumer equilibrium
12. Market structure, Theory of distribution – rent, wage, interest and profit

13. National Income and concepts, Methods of Calculating NI and difficulties
14. Money, Types and functions, Price indices
15. Theory of population, banking system in India
16. Inflation, types and control measures, Budgeting and Types of budgeting
- 17. Mid Semester Examination**
18. Taxation, Types and Importance, Circulation of economy, System / Types of Economy and its merits vs demerits
19. Concepts of farm management, Farm Management - Relation with other subject matters
20. Size of farming and determinants, Types of farming
21. System of farming, Economies of scale and size
22. Factor – Product relationship, Law of diminishing marginal returns
23. Factor – Factor relationship
24. Product – Product relationship, Law of Equi-marginal returns
25. Minimum cost – Maximum Profit principle, Comparative advantages
26. Basics of farm records and accounts, Types of farm records
27. Farm planning and budgeting, Complete budgeting and Partial budgeting
28. Risk and uncertainty in farming, Strategies to manage the risk and uncertainty
29. Concepts of resources and natural resources, Classification of resources
30. Property Rights: Common Property Resources (CPRs): meaning and characteristics of CPRs
31. Scarcity of resources and property rights, Externalities and common properties
32. Issues on common properties, Welfare loss due to externalities

Suggested Readings:

1. Seth, M.L., (2005). Principles of Economics, New Delhi: Lakshmi Narain Agarwal Co., Agra, pp 1- 888.
2. Subba Reddy, S., & Raghu Ram, P., (2018). Agricultural Economics, New Delh: Oxford & IBH. pp 1-650.
3. Koutsoyiannis, A.1983 Modern Micro Economics, The Macmilan Press Ltd., Hongkong
4. Dewett, K.K., (2004). Modern Economic Theory, New Delhi: Syamlal Charitable Trust. pp 1- 1024.
5. Debertin, D.L., (2012). Agricultural Production Economics. New York: Create Space Independent Publishing Platform. pp. 1-98.
6. Sankayan, P.L., (1983). Introduction to Farm Management. New Delhi: Tata McGraw Hill Publishing Company Ltd. pp. 1-86.

Web-References:

1. www.fp.unmas.ac.id/wp-content/uploads/2018/03/principles-of-agricultural-economics.pdf
2. www.economicshelp.org
3. www.sparknotes.com/economics

4. www.ediindia.org
5. www.iie.nic.in
6. www.niesbudtraining.org
7. www.nimsme.org
8. www.nsic.co.in

Course No.	:	AEG 201
Course Title	:	Farm Machinery and Power
Credit hours	:	1+1
Course category	:	Core Course

Course learning rationale/course objective (CLR):

The purpose of learning this course is:

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

Course learning outcomes (CLO):

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

THEORY

Unit 1: Farm power and Internal Combustion engine

Status of farm power in India; Sources of farm power, I.C. engines, working principles of I C engines; comparison of two stroke and four stroke cycle engines, study of different components of I.C. engine, I.C. engine terminology and solved problems;

Unit 2: Systems of IC Engine

Familiarization with different systems of I.C. engines, air cleaning, cooling, lubrication, fuel supply and hydraulic control system of a tractor;

Unit 3: Tractor systems and types

Familiarization with power transmission system, clutch, gear box, differential and final drive of a tractor; Tractor types; Cost analysis of tractor power and attached implement; Criteria for selection of tractor and machine implements.

Unit 4: Tillage implements

Familiarization with primary and secondary tillage implement; Implement for hill agriculture

Unit 5: Planting, Intercultural and Harvesting Equipments

Implement for intercultural operations, familiarization with sowing and planting equipment; calibration of a seed drill and solved examples; familiarization with plant protection equipment; familiarization with harvesting and threshing equipment.

Theory - Lecture Schedule

1. Introduction to farm power – sources, advantages, and disadvantages – current status of farm power in India - Farm mechanization – importance, scope, advantages, and limitations – types and uses of tractors and power tillers
2. Internal combustion engine – working principle – Two-stroke and four-stroke engines –Components of an internal combustion engine and their functions
3. Engine power terminology – measurement of engine power – solved problems
4. Fuel system – properties of fuel – fuel system in petrol and diesel engines- Air cleaners – types and functions
5. Lubrication systems – splash and forced feed types- Cooling systems – purpose and types, air-cooled and water-cooled systems
6. Power transmission system – function – clutch system - Transmission gears – sliding mesh and constant mesh systems
7. Brakes – principle of operation – classification – hydraulic control system- Differential unit – Final drive
8. Estimation of the cost of tractor power
9. **Mid Semester Examination**
10. Tillage – definition, objectives, and types – ploughing methods - gathering and casting

11. Primary tillage implements – components and accessories of mouldboard plough- Disc plough – types, construction – disc angle and tilt angle- chisel plough
12. Secondary tillage implements – functions and types – harrows and cultivators – Puddlers
13. Sowing method - Seed drill – components and their functions- seed metering mechanisms – Seed cum fertilizer drill – Planter – Function of planter- rice transplanter
14. Intercultural equipment – types of weeders - dryland and wetland – power weeders – Implement in hill agriculture
15. Sprayers: Functions, classification, components and different types of sprayers
16. Harvesting – principles of cutting crops –Mowers – types – cutter bar and its components- registration and alignment of mower – reaper – reaper binder- Components and working of combine harvester
17. Threshing - Principle, function and different types of thresher – threshing efficiency

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 plough, disc plough and disc harrow; Familiarization with seed-cum-fertilizer drills their seed metering mechanism and calibration, planters and trans planter; Familiarization with different types of sprayers and dusters; Familiarization with different inter-cultivation equipment; Familiarization with harvesting and threshing machinery; Calculation of power requirement for different implements.

Practical Schedule

1. Study of different components of I.C. Engine
2. Measurement and calculation of engine power
3. Study of air cleaning and cooling system
4. Study of lubrication and fuel supply system
5. Familiarization with clutch and transmission system
6. Study of brake, steering, and hydraulic control system
7. Tractor driving practice by students under supervision in the field
8. Power tiller driving practice by students in the field
9. Study of primary tillage implements – mould board and disc plough – Hitching and Adjustment of MB plough
10. Study of secondary tillage implements – Harrow and cultivators
11. Study of intercultural equipment – operation of dry land, wet land and power weeder in field

12. Study of seed-cum-fertilizer drill and metering mechanism-calibration of Seed Drill
13. Study and operation of machinery for rice cultivation
14. Study of sprayer – Identification of components and operation of power sprayer
15. Familiarization with harvesting and threshing Machinery
16. Estimation of the cost of tractor power
- 17. Final Practical Examination**

Suggested Readings:

1. Jagdiswar Sahay – Elements of Agricultural Engineering
2. Jain, S.C. and C.R. Rai-Farm Tractor and maintenance and repair. Standard Publishers, 1705-B, Naisarak. Delhi- 110006
3. Ojha, T.P. and A.M. Michael, A.M. Principles of Agricultural Engineering. Vol.I. Jain brothers, 16/893, East Park Road, Karol Bagh, New Delhi -110005
4. Surendra Singh- Farm machinery –Principles and applications, ICAR, New Delhi

Course No.	:	AGR 203
Course Title	:	Water Management
Credit Hours	:	1+1
Course Category	:	Core Course

Course Learning Rationale / Course Objectives (CLR):

1. To study the important properties of soil affecting water availability to crops and water requirement for optimum growth and development
2. To study different methods of irrigation and water management practices of both field and horticultural crops.
3. To study the quality of irrigation water, agricultural drainage and artificial intelligence.

Course Learning Outcome (CLO):

1. Knowing the importance of irrigation in agriculture and availability of water resources.
2. Understanding the soil - plant - water relationship
3. Gaining knowledge on water management practices in important field and horticultural crops
4. Gaining knowledge on different methods of irrigation
5. Knowing about irrigation water quality, drainage and Artificial intelligence

THEORY

Unit 1: Irrigation - History and importance - Water resources

Irrigation: definition and objectives; Importance of irrigation - Function of water for plant growth - History and development of irrigation in India - Irrigation systems of India and Tamil Nadu. Water resources and irrigation potential of India, Tamil Nadu and Puducherry – Water budgeting

Unit 2: Soil-water-plant relationship

Soil-plant-water relationship - Soil-plant atmospheric continuum - Soil water movement - Absorption of water - Evapotranspiration - Hydrological cycle - Kinds of soil water - Soil moisture constants - Rooting characteristics and Moisture extraction pattern - Plant water stress and its effect and methods to overcome stress

Unit 3: 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 - Water management for different field and horticultural crops (rice, wheat, maize, sorghum, bajra, ragi, pulses, groundnut, sesame, cotton, jute, sugarcane, mango, banana and tomato)

Unit 4: 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 limitations - fertigation, economic use of irrigation water; Layout of underground pipeline system, Irrigation automation. Irrigation efficiency and Water use efficiency - Methods to improve WUE - Conjunctive use of water

Unit 5: Quality of irrigation water and drainage. Artificial Intelligence

Quality of irrigation water and its management - Agronomic practices for use of poor quality water (saline, effluent and sewage water) for irrigation - on-farm development - command area development - Agricultural drainage, importance and methods of drainage. Artificial Intelligence and climate-based irrigation practices and its management.

Theory - Lecture Schedule

1. Irrigation: definition and objectives; Importance of irrigation - Function of water for plant growth.
2. History and development of irrigation in India - Irrigation systems of India and Tamil Nadu.
3. Water resources and irrigation potential of India, Tamil Nadu and Puducherry – Water budgeting
4. Soil-plant-water relationship - Soil-plant atmospheric continuum - Soil water movement - Absorption of water - Evapotranspiration
5. Hydrological cycle - Kind of soil water - Soil moisture constants

6. Rooting characteristics and Moisture extraction pattern - Plant water stress and its effect and methods to overcome stress
7. Crop water requirement - Effective rainfall - Potential evapotranspiration (PET) and consumptive use - Definition and estimation
8. Factors affecting water requirement - Critical stages for irrigation; water requirement and Water management for different field and horticultural crops (rice, wheat, maize, sorghum, bajra, ragi, pulses, groundnut, sesame, cotton, jute, sugarcane, mango, banana and tomato)
9. **Mid Semester Examination**
10. Scheduling of irrigation - Different approaches
11. Methods of irrigation: surface, sub-surface
12. Sprinkler and drip irrigation - Micro irrigation: layout, suitability, merits and limitations - Fertigation, economic use of irrigation water
13. Layout of underground pipeline system, Irrigation automation.
14. Irrigation efficiency and Water use efficiency - Methods to improve WUE - Conjunctive use of water
15. Quality of irrigation water and its management - Agronomic practices for use of poor quality water (saline, effluent and sewage water) for irrigation
16. On-farm development - command area development - Agricultural drainage, importance and methods of drainage.
17. Artificial Intelligence and climate-based irrigation practices and its management.

Practical

Determination of bulk density, particle density and porosity by different methods; Determination of soil moisture content by gravimetric method and volumetric method, tensiometer, electrical resistance block and neutron moisture meter; Determination of Maximum Water Holding Capacity: Determination of field capacity by field method; Determination of permanent wilting point; Measurement of irrigation water by using water measuring devices viz., flumes, weirs, notches, orifices; Calculation of irrigation water requirement and different efficiencies; Determination of infiltration rate; Scheduling of irrigation: Demonstration of Surface irrigation methods (furrow method of irrigation; Demonstration of check basin and basin method, Border Strip and Broad bed furrow method of irrigation); Layout, operation and maintenance of sprinkler irrigation system. Layout, operation and maintenance of Drip irrigation system. Measurement of emitter discharge rate, wetted diameter and calculation of emitter discharge variability; Demonstration of filter cleaning, fertigation, injection and flushing of laterals; Visit to farmers' field and cost estimation of drip irrigation system; Visit to irrigation research centre/ station and visit to command area.

Practical Schedule

1. Determination of soil bulk density, particle density and porosity by different methods
2. Determination of soil moisture content by gravimetric method and volumetric method.
3. Determination of soil moisture by indirect methods - tensiometer, electrical resistance block and neutron moisture meter.

4. Determination of Maximum Water Holding Capacity
5. Determination of field capacity by field method. Determination of permanent wilting point.
6. Measurement of irrigation water by using water measuring devices viz., flumes, weirs, notches, orifices.
7. Calculation of irrigation water requirement. Different efficiencies.
8. Determination of infiltration rate.
9. Scheduling of irrigation
10. Demonstration Surface irrigation methods – I (Furrow method of irrigation; check basin and basin method of irrigation).
11. Demonstration of Surface irrigation methods – II (Border Strip and Broad bed furrow method)
12. Layout, operation and maintenance of sprinkler irrigation system
13. Layout, operation and maintenance of Drip irrigation system. Measurement of emitter discharge rate, wetted diameter and calculation of emitter discharge variability.
14. Demonstration of filter cleaning, fertigation, injection and flushing of laterals.
15. Visit to farmers' field and cost estimation of drip irrigation system.
16. Visit to irrigation research centre/ station and visit to command area.
- 17. Final Practical Examination**

Suggested Readings:

1. Lenka, D. 1999. Irrigation and Drainage. Kalyani Publishers.
2. Michael, A.M. 2007. Irrigation: Theory and Practice Vikas Publishing House Private Ltd.
3. Rao, Y.P and S.R.Bhaskar. 2008. Irrigation technology – theory and practice. Agrotech publishing Academy, 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 of field crops: Principles and Practices. ICAR Publication.
7. Sankara Reddi, G.H. and T. Yellamanda Reddy. 2005. Efficient use of irrigation water. Kalyani Publishers
8. Panda, S.C. 2009. Principles and Practices of water management. Agro-bios Publishers.
9. Dilipkumar Mujumdar. 2013. Irrigation water management: Principles and Practices. Prentice Hall of India Pvt. Ltd.,
10. S.V. Patil & Rajakumar, G. R., Water Management in Agriculture and Horticultural Crops. Satish serial publishing House, Delhi.

Course No.	:	AGR 204
Course Title	:	Crop Production Technology-II (<i>Rabi Crops</i>)
Credit Hours	:	1+2*
Course Category	:	Core Course

*Practical Crop Production- one (1) credit from practical of the course is allotted for Practical Crop Production of selected *Rabi* crops covered under this course.

Course Learning Rationale / Course Objective (CLR):

The purpose of learning this course is:

1. To impart basic and fundamental knowledge on principles and practices of *rabi* crop production.
2. To impart knowledge and skill on scientific crop production and management.

Course Learning Outcome (CLO):

1. To identify and describe morphological traits, ecological needs, and varietal features of major *rabi* crops.
2. Acquire hands-on experience / skills and practical knowledge in the scientific cultivation and management of *rabi* crops.
3. Acquire hands-on skills and practical knowledge in the scientific cultivation and management of selected *rabi* crop under practical crop production.

THEORY

Unit 1: Cereals

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

Unit 2: Pulses

Origin, geographical distribution, economic importance, soil and climatic requirements, varieties, cultural practices and yield of chickpea, lentil, peas. *Rabi* redgram and, rajmash.

Unit 3: Oilseeds

Origin, geographical distribution, economic importance, soil and climatic requirements, varieties, cultural practices and yield of Rapeseed, Mustard, Sunflower, Safflower and Linseed

Unit 4: Sugar crops

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

Unit 5: Forage crops and other *rabi* crops

Origin, geographical distribution, economic importance, soil and climatic requirements, varieties, cultural practices and yield of Berseem, Lucern and oats; potato, quinoa and tobacco

Theory - Lecture Schedule

1. Importance, area, production and productivity of *rabi* crops.
2. Wheat – Origin, geographical distribution, economic importance, soil and climatic requirements, varieties, cultural practices, yield.
3. Barley – Origin, geographical distribution, economic importance, soil and climatic requirements, varieties, cultural practices, yield.
4. Chickpea – Origin, geographical distribution, economic importance, soil and climatic requirements, varieties, cultural practices, yield.
5. Lentil – Origin, geographical distribution, economic importance, soil and climatic requirements, varieties, cultural practices, yield.
6. Peas – Origin, geographical distribution, economic importance, soil and climatic requirements, varieties, cultural practices, yield.
7. *Rabi* red gram and rajmah – Origin, geographical distribution, economic importance, soil and climatic requirements, varieties, cultural practices, yield.
8. Rapeseed and Mustard – Origin, geographical distribution, economic importance, soil and climatic requirements, varieties, cultural practices, yield.

9. Mid Semester Examination

10. Sunflower – Origin, geographical distribution, economic importance, soil and climatic requirements, varieties, cultural practices, yield.
11. Safflower and Linseed – Origin, geographical distribution, economic importance, soil and climatic requirements, varieties, cultural practices, yield.
12. Sugarcane – Origin, geographical distribution, economic importance, soil and climatic requirements, varieties
13. Sugarcane – cultural practices, yield.
14. Sugarbeet – Origin, geographical distribution, economic importance, soil and climatic requirements, varieties, cultural practices, yield.
15. Forage crops - Berseem, Lucerne and Oats – Origin, geographical distribution, economic importance, soil and climatic requirements, varieties, cultural practices, yield.
16. Potato and Quinoa – Origin, geographical distribution, economic importance, soil and climatic requirements, varieties, cultural practices, yield.
17. Tobacco – Origin, geographical distribution, economic importance, soil and climatic requirements, varieties, cultural practices, yield.

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.

***Practical syllabus for Rabi Practical Crop Production:**

Ecosystem - Climate and weather - Seasons and varieties of India. Selection of field - Main field preparation – sowing - Application of manures and fertilizers - Weed management and practicing pre and post 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.

- Each student will be allotted a minimum land area of 100 to 200 m² 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 *Rabi* ID crop (*rabi* redgram / sunflower/ or any other *rabi* crop).

Practical Schedule

1. Identification of seeds of *rabi* crops
2. Selection of field for ID crop cultivation
3. Acquiring skill on different seed treatment techniques in *rabi* crops
4. Acquiring skill in seed treatment practices for ID crop
5. Study of methods of sowing of *rabi* crops
6. Study and practice of main field preparation for ID crop
7. Layout and raising of crop cafeteria
8. Practicing of application of manures and fertilizers for ID crop
9. Study of different methods of planting of Sugarcane
10. Practicing sowing of ID crop/ exposure to mechanized sowing
11. Study of morphological characteristics of *rabi* crops
12. Acquiring skill in pre-emergence application of herbicides
13. Identification of weeds in *rabi* crops
14. Estimation of plant population and acquiring skill in gap filling and thinning
15. Study on after cultivation practices of *rabi* crops
16. Study of weeds and weed management in ID crop / exposure to mechanized weeder
17. Recording of bio-metric observations of *rabi* crops.
18. Observation on nutritional deficiency symptoms and corrective measures
19. Study of yield contributing characters of *rabi* crops.
20. Recording growth parameters and assessing dry matter production
21. Estimation of theoretical yield for *rabi* crops.
22. Study of water management practices for ID crop
23. Study on juice quality analysis of sugarcane
24. Observation of insect pests and diseases and their management
25. Working out economics of cultivation of *rabi* crops

26. Observation of yield parameters and yield estimation for selected ID crop
27. Visit to forage production farm
28. Harvesting, threshing and cleaning of the produce
29. Study of important agronomic experiments of *rabi* crops at experimental farms
30. Exposure to mechanized harvesting and threshing.
31. Visit to research stations of *rabi* crops
32. Preparation of balance sheet including cost of cultivation and net returns per student
33. Final practical evaluation for practical crop production
34. **Final Practical Examination**

Suggested Readings:

1. B. Gurarajan, R. Balasubramanian and V. Swaminathan. Recent Strategies on Crop Production. Kalyani Publishers, New Delhi.
2. Chidida Singh.1997. Modern techniques of raising field crops. Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi.
3. Rajendra Prasad. Textbook of Field Crops Production - Commercial Crops. Volume II ICAR Publication.
4. Rajendra Prasad. Textbook of Field Crops Production - Foodgrain Crops. Volume I ICAR Publication.
5. S.R. Reddy. 2009. Agronomy of Field Crops. Kalyani Publishers, New Delhi.
6. S.S. Singh. 2005. Crop Management. Kalyani Publishers, New Delhi.
7. Rajendra Prasad. 2002. Text Book of Field Crops Production, ICAR, New Delhi.
8. Reddy, S.R. 2004. Agronomy of Field crops, Kalyani Publishers, Ludhiana.
9. Subhash Chandra Bose, M. and Balakrishnan, V. 2001. Forage Production South Asian Publishers, New Delhi.
10. UAS, Bangalore. 2011. Package of Practice. UAS, Bengaluru.
11. Directorate of Agriculture, Chennai and TNAU, Coimbatore. 2020. Crop Production Guide Agriculture 2020.

Course No	:	GPB 202
Course Title	:	Basics of Plant Breeding
Credit Hours	:	2+1
Course Category	:	Core Course

Course Learning Rationale / Course Objective (CLR):

The purpose of learning this course is:

1. Introduce the basic concepts of heredity, genetic variation, and their application in plant breeding.

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

Course Learning Outcomes (CLO):

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

THEORY

Unit 1: Reproductive systems in plant breeding

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

Unit 2: Breeding methods of self-pollinated crops

Plant introduction as a breeding method – types of introduction – objectives – quarantine - acclimatization – achievements - merits and demerits. Genetic basis of self-pollinated crops – Vilmorin's principle of progeny selection - Johannsen's pure line theory. Breeding methods for self-pollinated crops without involving artificial hybridization: Pure line selection – procedure – merits and demerits – achievements; Mass selection– procedure - types – merits and demerits achievements- comparison of

mass and pureline selection. Breeding methods of self-pollinated crops involving artificial hybridization: Creating variability in self-pollinated crops - Hybridization and selection – objectives – steps in hybridization - choice of parents – kinds of emasculation – hybridization- transgressive breeding. Handling segregating generations- Pedigree breeding – procedure – mass pedigree – merits – demerits – achievements; Bulk breeding – procedure – merits – demerits – achievements. Comparison of pedigree and bulk breeding methods. Single Seed Descent (SSD) method – procedure – application – merits and demerits. Backcross breeding – genetic basis — procedures for transferring dominant and recessive genes. Back cross breeding – merits – demerits – multilines- types- procedure- merits and demerits.

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

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

Unit 4: Special breeding methods

Polyploidy breeding – classification – induction of polyploidy - achievements – limitations. Wide hybridization-importance-barriers and techniques for overcoming barriers-utilization- Pre breeding. Mutation breeding: mutation – types – mutagens – breeding procedure – achievements – limitations. Concepts in biotic stress resistance breeding- diseases and pests - gene for gene hypothesis-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 5: Varietal Release, Maintenance Breeding, Markers and IPR

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

Theory - Lecture Schedule

1. Objectives, role, and nature of plant breeding; historical development.
2. Central dogma of plant breeding; phases of plant breeding.

3. Centres of origin and diversity; contributions of Vavilov, Harlan, and Zhukovsky; law of homologous series.
4. Domestication, acclimatization, and introduction; major achievements and future prospects.
5. Plant genetic resources – importance, germplasm types and activities, gene erosion, collection, conservation strategies.
6. Germplasm evaluation – use of descriptors, documentation, utilization; national and international agencies; germplasm exchange and quarantine.
7. Modes of reproduction – sexual, asexual, alternation of generation; mechanisms promoting self- and cross-pollination.
8. Self-incompatibility – classifications, mechanisms, applications, and methods to overcome.
9. Male sterility – CMS, GMS, CGMS – inheritance and applications.
10. EGMS – TGMS, PGMS; gametocides and transgenic male sterility – principles and applications; apomixis and parthenocarpy.
11. Genetic variation – polygenic traits; components of variance; heritability and genetic advance.
12. Genetic basis of self-pollinated crops – Vilmorin's principle and Johanssen's pure line theory.
13. Plant introduction as a breeding method – types, objectives, quarantine, acclimatization, merits, demerits, and achievements.
14. Breeding methods in self-pollinated crops: pure line and mass selection – procedures, merits, demerits, and achievements.
15. Hybridization in self-pollinated crops – creating variability, objectives, emasculation methods, choice of parents, transgressive breeding.
16. Handling segregating generations – pedigree method, bulk method – procedures, merits, demerits, and achievements.

17. Mid Semester Examination

18. Comparison of pedigree and bulk methods; Single Seed Descent (SSD) method – procedure, merits, and limitations Backcross breeding – genetic basis, procedure for transferring dominant and recessive genes; multilines – types, development, and applications.
19. Genetic structure of cross-pollinated crops – Hardy-Weinberg law and gene frequencies.
20. Mass selection in cross-pollinated crops – modified mass selection, progeny selection, and grid selection.
21. Recurrent selection – principles, types (simple, restricted, reciprocal), merits, and limitations.
22. Heterosis breeding – genetic basis, heterosis theories, inbreeding depression, estimation of heterosis.
23. Inbred line development, top cross and single cross methods, prediction of double cross performance; types of hybrids and achievements.
24. Synthetic and composite varieties – development procedures, applications, merits, and achievements.

25. Asexual reproduction – genetic characteristics; clonal selection and hybridization; merits, limitations, and achievements.
26. Polyploidy – types, induction methods, role in crop improvement, achievements, and limitations. Wide hybridization – barriers, techniques for overcoming, significance in pre-breeding.
27. Mutation breeding – types of mutations and mutagens, procedure, achievements, and limitations.
28. Breeding for biotic stress resistance – disease and pest resistance, gene-for-gene hypothesis, sources, gene pyramiding, and deployment strategies
29. Breeding for abiotic stress resistance – drought tolerance mechanisms, key traits, physiological basis, sources, and methods.
30. Variety release process – criteria and procedures; seed multiplication stages – nucleus and breeder seed production
31. Introduction to molecular markers – morphological, biochemical, DNA markers; QTL mapping and marker-assisted selection. Role of biotechnological tools in plant breeding – advantages, applications, and limitations
32. Participatory plant breeding – concepts, practices, significance in modern breeding programs. Intellectual Property Rights – plant breeders' and farmers' rights, patenting, and legal frameworks.

Practical

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

Practical Schedule

1. Reproduction in plants - Alternation of generation and life cycle
2. Mode of pollination, Mechanisms enforcing self-pollination in crops
3. Mode of pollination - Mechanisms enforcing Cross-pollination in crops
4. Germplasm collection and conservation.
5. Breeder's kit and its components
6. Basic techniques for selfing and crossing in crop plants
7. Emasculation and pollination techniques in Kharif crops I.
8. Emasculation and pollination techniques in Kharif crops II
9. Study of male sterility system – CMS, GMS and CGMS
10. Mutagenesis study using physical and chemical mutagens
11. Breeding management system - Handling of segregating populations, maintenance of records
12. Experimental designs used in plant breeding-RBD analysis

13. Calculation of mean, range, PCV, GCV, heritability, genetic advance
14. Estimation of heterosis and prediction performance of double cross hybrids
15. Phenotyping techniques for biotic stresses
16. Phenotyping techniques for abiotic stresses
17. **Final Practical Examination**

Suggested Readings:

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

Course No.	:	HOR 212
Course Title	:	Production Technology of Vegetables and Spices
Credit Hours	:	1+1
Course Category	:	Core Course

Course Learning Rationale / Course Objective (CLR):

The purpose of learning this course is to:

1. Educate about the different forms of classification of vegetables.
2. Impart knowledge about the origin, area, climate, soil, improved varieties and cultivation practices of vegetables and spices.
3. Understand and identify physiological disorders of major vegetable and spice crops.

Course Learning Outcomes (CLO):

1. Classify vegetable and spice crops based on scientific criteria.
2. Describe origin, climatic requirements, soil conditions and area of cultivation.
3. Apply recommended cultivation practices for important vegetables and spices.
4. Recognize and manage physiological disorders in vegetables and spices.
5. Appreciate the economic importance and post-harvest value addition of vegetable and spice crops.

THEORY

Unit 1: Introduction and importance of Vegetable Crops

Importance of vegetables and spices in human nutrition and national economy. Principles and scope of kitchen gardening. Classification of vegetables. Brief overview of origin, area, climate and soil requirements for major vegetable and spice crops.

Unit 2: Cultivation practices for solanaceous crops

Tomato, brinjal, chilli and capsicum; and other crops like okra and moringa. Topics include transplanting, spacing, nutrient and water management, weed control, harvesting and physiological disorders.

Unit 3: Cultivation practices for cucurbits

Cucumber, bitter gourd, bottle gourd and pumpkin; legumes such as French bean and peas; and root and tuber crops like carrot, radish, beetroot, sweet potato, cassava and potato. Emphasis on crop-specific practices and disorders.

Unit 4: Cultivation of cole crops, bulbs and leafy vegetables

Cabbage, cauliflower and knol-khol; bulb crops like onion and garlic; and leafy vegetables such as amaranth and palak. Special focus on perennial vegetables, physiological issues and post-harvest handling.

Unit 5: Cultivation of Spice crop

Production covering turmeric, ginger, garlic, coriander, cumin, black pepper, cardamom, fenugreek, fennel, clove, nutmeg, cinnamon, curry leaf, tamarind and herbal spices. Includes propagation techniques, crop-specific practices, harvesting and economic considerations.

Theory – Lecture Schedule

1. Introduction to the importance of vegetables and spices in human nutrition and national economy. Classification systems and kitchen gardening concepts.
2. Origin, distribution, climate and soil requirements of major vegetable crops.
3. Improved varieties and sowing/transplanting techniques for vegetable crops.
4. Cultivation practices for tomato, brinjal, chilli and capsicum.
5. Cultivation practices for okra and moringa.
6. Cultivation of cucurbits (cucumber, bitter gourd, bottle gourd, pumpkin) and legumes (French bean, peas).
7. Cultivation of sweet potato, cassava, carrot, radish and beetroot.
8. Cultivation of potato and peas.
9. **Mid Semester Examination**
10. Physiological disorders in cucurbits, root and tuber crops.
11. Cultivation of cole crops – cabbage, cauliflower and knol-khol.
12. Cultivation of bulb crops – onion and garlic and leafy vegetables like amaranth and palak.
13. Cultivation of perennial vegetables and their management.

14. Spice crop production – turmeric, ginger, coriander, cumin and garlic.
15. Spice crop production – black pepper, cardamom, clove, cinnamon, tamarind.
16. Identification and control of physiological disorders in spices
17. Post-harvest handling techniques.

Practical

Identification of vegetables and spice crops and their seeds. Description of varieties. Propagation methods - rapid multiplication techniques - seed collection and extraction. Nursery raising. Direct seed sowing and transplanting. Study of morphological characters of different vegetables and spices. Fertilizers applications. Harvesting and post-harvest practices, Economics of vegetables and spices cultivation, visit to spice gardens.

Practical Schedule

1. Identification of vegetable and spice crops and their seeds.
2. Study and description of improved varieties of vegetables and spices.
3. Propagation methods and nursery techniques.
4. Rapid multiplication techniques in selected vegetable crops.
5. Seed collection and extraction from matured fruits.
6. Nursery practices specific to spice crops.
7. Direct seed sowing and transplanting methods.
8. Study of morphological features of various vegetable and spice crops.
9. Application of fertilizers and nutrient management.
10. Identification and diagnosis of physiological disorders in vegetable crops.
11. Harvesting techniques for vegetables.
12. Post-harvest handling, grading and storage of vegetables.
13. Harvesting and handling of spice crops.
14. Estimation of economics for selected vegetable and spice crops.
15. Visit to a spice garden
16. Visit to vegetable demonstration farm
17. **Final practical examination**

Suggested Readings:

1. Singh, K.P. & Bahadur, A. *Olericulture: Fundamentals of Vegetable Production (Vol. 1)*
2. Kabir, J., Bose, T.K., & Som, M.G. *Vegetable Crops*
3. Fagaria, M.S., Choudhury, B.R., & Dhaka, R.S. *Vegetable Crops (Production Technology, Vol. II)*

Course No.	:	SAC 201
Course Title	:	Problematic Soils and their management
Credit Hours	:	1+1
Course Category	:	Core Course

Course Learning Rationale/ Course objective (CLR):

The purpose of learning this course is;

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

Course Learning Outcomes (CLO):

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

1. About various types of problematic soils.
2. About the management processes and reclamation techniques for these soils.
3. About irrigation water, remote sensing, GIS for diagnosis and management, and bioremediation of problem soils.

THEORY

Unit 1: Problem soil and soil quality

Soil quality and health, Distribution of Waste land and problem soils in India, Categorization of Problem soils based on properties.

Unit 2: Chemical constraints

Reclamation and management of Acid soils, Saline, Sodic soils, Acid Sulphate soils.

Unit 3: Physical constraints and polluted soil

Soil physical constraints and management. Eroded and Compacted soils, polluted soils. Contaminated soils (Pesticide contamination, Heavy metal contamination), Mined soils (Coal mined, Oil mined), Management of Riverine soils, Waterlogged soils.

Unit 4: Quality of irrigation water

Irrigation water – quality and standards, utilization of saline water in agriculture.

Unit 5: Remote sensing and GIS in Agriculture and Remediation of soils

Use of Remote sensing and GIS in diagnosis and management of problem soils. Irrigation and water quality. Multipurpose tree (MPT) species, bio remediation through MPTs of soils, land capability and classification, land suitability classification.

Theory – 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 – Formation, Characteristics, Effect of salinity on plant growth and nutrient availability - Reclamation and management.
4. Sodic soils - Formation, Characteristics, - Effect of sodicity on plant growth and nutrient availability - Reclamation and management.
5. Acid soils – 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 and Mined soils
- 9. Mid Semester Examination**
10. Soil pollution - Potentially toxic elements - Excessive use of fertilizers, pesticides and weedicides – Heavy metal contamination – Management.
11. Irrigation water – Quality and standard parameters
12. Utilization of saline water in agriculture
13. Remote Sensing and GIS techniques in diagnosis, mapping and management of degraded and problematic soils.
14. Bio-remediation of problem soils through Multi-Purpose Tree Species.
15. Taxonomic classification of soils - Land Capability Classification.
16. Land suitability classification - Index – Criteria - Different approaches
17. Land suitability for different crops.

Practical

Determination of pHs and EC of saturation extract of problematic soil. Determination of redox potential in soil, Estimation of water soluble and exchangeable cations in soil and computation of SAR and ESP and characterization of problematic soil. Determination of Gypsum requirement of alkali / sodic soil. Determination of lime requirement of acidic soil. Determination of Quality of irrigation water (pH, EC, Ca, Mg,

Na, CO₃, HCO₃, Cl, SAR and RSC), Determination of nitrate (NO₃⁻) from irrigation water, Determination of dissolved oxygen and free carbon dioxide levels in water samples.

Practical Schedule

1. Determination of pH and EC of saturation paste extract of problematic soil
2. Determination of redox potential in soil.
3. Determination of water soluble and exchangeable Ca and Mg in soil
4. Determination of water soluble and exchangeable Na and K in soil
5. Computation of SAR, ESP and characterization of problematic soil
6. Determination of Gypsum requirement of alkali/ sodic soil
7. Determination of lime requirement of acidic soil
8. Collection of different types of irrigation water samples and estimation of pH, EC
9. Estimation of calcium and magnesium in irrigation water
10. Estimation of sodium and potassium in irrigation water
11. Estimation of carbonate and bicarbonate in irrigation water
12. Estimation of chloride and sulphate in irrigation water
13. Determination of nitrate in irrigation water
14. Determination of free carbon dioxide levels in water samples.
15. Classification of irrigation waters as per USSL and other systems.
16. Computation of salt in water
- 17. Final Practical Examination**

Suggested Readings:

1. Agarwal, R.R., Yadav, J.S.P. and Gupta, R.N. (1982). Saline Alkali soils of India, ICAR, AGROBIOS (India).
2. Brady Nyle C and Ray R Well. 2014. Nature and properties of soils. Pearson Education Inc., New D Delhi.
3. Cirsan J. Paul. 1985. Principles of Remote Sensing. Longman, New York
4. Indian Society of Soil Science. 2002. Fundamentals of Soil Science. IARI, New Delhi.
5. Osman, Khan Towhid., 2018. Management of Soil Problems. Springer publication
6. Srivastava, V. C., 2002. Management of Problem Soils -Principles and Practices New Delhi
7. Brady, N. C. and Well, R. R. 2014. Nature and properties of soils. Pearson Education Inc., New Delhi.
8. Das, D. K. 2011. Introductory Soil Science (3rd Edition), Kalyani publisher, Ludhiana (India).
9. Gupta, P. K. 2009. Soil, Plant, Water and Fertilizer Analysis (2nd Edition), Agrobios, Jodhpur (India).

10. Indian Society of Soil Science (ISSS) 2002. Fundamentals of Soil Science, IARI, New Delhi.
11. Mehra, R. K. 2004. Text Book of Soil Science, ICAR, New Delhi.

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

Course Learning Rationale / Course Objective (CLR):

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

Course Learning Outcomes (CLO):

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

THEORY

Unit 1: Introduction to Computers

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

Unit 2: Word Processing Software & Electronic Spreadsheet Software

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

Unit 3: Presentation Software & Database Software

LibreOffice Impress - Creating Slides, Slide Show, Animation, & Transition

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

Unit 4: Statistical Analysis and Programming Using R Software

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

Unit 5: Agricultural Informatics & Artificial Intelligence

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

Theory - Lecture Schedule

1. Introduction to Computers, Hardware, Software, Block Diagram of a Computer,
2. Primary Storage, Secondary Storage, Input Devices, Output Devices
3. Copy, Move, Rename Using Linux File Manager Files,
4. Delete & Trash File/Folder Using Linux File Manager Files,
5. Personal Area Network (PAN), Local Area Network (LAN), Metropolitan Area Network (MAN), Wide Area Network (WAN),
6. Internet, Virtual Private Network (VPN), World Wide Web (WWW)
7. Browser, Email, Compose, To, CC, BCC, Subject,
8. Email - Attach Files, Inbox, Sent, Forward, Reply
9. Word Processing Software, Libreoffice Writer, Creating, Editing, Saving Document, Changing
10. Libreoffice Writer - Font, Font Size, Font Color, Bold, Italic, Underline,
11. Libreoffice Writer - Align Left, Align Right, Align Center, Align Justify, Cut, Copy, Paste
12. Electronic Spreadsheet Software, Libreoffice Calc, Formula For Sum And Average, Creating Graphs
13. Presentation Software, LibreOffice Impress, Creating Slides, Slide Show,
14. LibreOffice Impress - Animation, & Transition
15. Database Software, LibreOffice Base, Creating Table in Design View,
16. Create using Wizard - Queries, Forms, And Reports
17. **Mid Semester Examination**
18. Statistical Analysis and Programming Using R, R Console, R Prompt > , Assignment operator = or <- ,
19. R Script,
20. scan("stdin"), print(),

21. `if(){} , if(){}else{} ,`
22. `if(){}else if(){}else{} ,`
23. `list() ,`
24. `for(){} ,`
25. Import Dataset From Clipboard to Dataframe Using `read.table()`,
26. Using R Find Sum, Mean,
27. Using R Standard Deviation and Correlation
28. Agricultural Informatics, E-Agriculture, Geospatial Technology, Agriculture Expert System, IoT and Big Data in Agriculture,
29. Smartphone Apps in Agriculture, Computer Controlled Devices (Automated Systems) in Agriculture
30. Artificial Intelligence (AI), Turing Test, Depth First Search,
31. Breadth First Search, Best First Search,
32. Beam Search, A*(Star) Search

Practical

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

Practical Schedule

1. Block Diagram of a Computer, Copy, Move, Rename, Delete & Trash File/Folder Using Linux File Manager Files
2. Email - Compose, To, Subject, CC, BCC, Attach Files, Inbox, Sent, Forward, Reply
3. Libreoffice Writer - Creating, Editing, Saving Document, Changing Font, Font Size, Font Color
4. Libreoffice Writer - Bold, Italic, Underline, Align Left, Align Right, Align Center, Align Justify, Cut, Copy, Paste
5. Libreoffice Calc - Formula For Sum And Average, Creating Graphs
6. LibreOffice Impress - Creating Slides, Slide Show
7. LibreOffice Impress - Animation, Transition
8. LibreOffice Base - Creating Table in Design View, Create using Wizard – Queries, Forms, Reports
9. R Software - R Console, R Prompt `>` , Assignment operator `=` or `<-`, R Script
10. R Script – `scan("stdin")`, `print()`

11. R Script – `if() {}`, `if() {} else {}`
12. R Script - `if() {} else if() {} else {}`
13. R Script – `list()`, R Script - `for() {}`
14. R - Import Dataset From Clipboard to Dataframe Using `read.table()`,
15. Using R Find Sum, Mean
16. Using R Find Standard Deviation And Correlation
17. **Final Practical Examination**

Suggested Readings:

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

THIRD YEAR**V SEMESTER**

Sl.No.	Course No.	Course Title	Discipline	Cr.Hr.
1.	AEN 301	Pest management in Crops and Stored Grains	AEN	2+1
2.	AGR 301	Introduction to Agro-meteorology	AGR	1+1
3.	AGR 302	Weed Management	AGR	1+1
4.	CRP 301	Fundamentals of Crop Physiology	CRP	2+1
5.	FOR 301	Introductory Agro forestry	HOR	1+1
6.	GPB 301	Crop Improvement (<i>kharif</i> crops) - I	PBG	1+1
7.	HOR 311	Ornamental Crops, MAPs and Landscaping	HOR	1+1
8.	PAT 301	Diseases of Field & Horticultural Crops & their Management	PAT	2+1
9.	MDC 301	Agricultural Marketing and Trade	AEC & AEX	2+1
10.	PJN 301*	Educational Tour	-	0+2*
		TOTAL		13+9=22

*Non-Gradual Course

Course No.	:	AEN 301
Course Title	:	Pest Management in Crops and Stored Grains
Credit Hours	:	2+1
Course Category	:	Core Course

Course Learning Rationale / Course Objective (CLR):

1. To diagnose the damage symptoms of different pests in field and horticultural crops
2. To study the distribution, biology of insect pests
3. To study the management practices for the major pests of field and horticultural crops
4. To study the stored product pests and their management techniques
5. To study the concepts of IPM, insecticide formulations and AI in pest management

Course Learning Outcomes (CLO):

1. Recognize pest damage symptoms in field and horticultural crops
2. Understand the biology and distribution of major insect pests
3. Apply suitable pest management practices for crop protection
4. Identify stored product pests and their control measures
5. Understand IPM concepts, insecticide use, and the role of AI in pest management

THEORY

Unit 1: Pests of field crops

General description on nature and type of damage by different arthropod pests; Scientific name, order, family, host range, distribution, biology and bionomics; Nature of damage and management of major insect pests of various field crops.

Unit 2: Pests of vegetable and fruit crops

Scientific name, order, family, host range, distribution, biology and bionomics; Nature of damage and management of major insect pests of vegetable crops and fruit crops.

Unit 3: Pests of plantation crops, ornamental crops, spices and condiments

Scientific name, order, family, host range, distribution, biology and bionomics; Nature of damage and management of major insect pests of plantation crops, ornamental crops, spices and condiments. Structural entomology and important household pests, their nature of damage and management.

Unit 4: Pests of stored product and non-insect pests

Factors affecting loss of stored grains. Insect pests, mites, rodents, birds and microorganisms associated with stored grains and their management. Storage structures and methods of grain storage and fundamental principles of stored grains management. Management of non-insect pest of crops - mites, snails and slugs.

Unit 5: Integrated Pest Management

Concept of IPM, Practices, scope and limitations of IPM. Classification of insecticides, toxicity of insecticides and formulations of insecticides, Biorational pesticides including insect repellents, antifeedants, Use of drones and AI in pest management.

Theory - Lecture Schedule

1. General description on nature and type of damage by different arthropod pests. Scientific name, order, family, host range, distribution, biology and bionomics; Nature of damage and management of major insect pests of rice
2. Pests of maize, sorghum, wheat and ragi
3. Pests of redgram, bengalgram, blackgram, greengram and cowpea
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 potato, sweet potato and tapioca
11. Pests of mango
12. Pests of citrus and banana
13. Pests of guava, grapevine and sapota
14. Pests of pomegranate, papaya, anola and apple
15. Pests of coconut and arecanut
16. Pests of tea and coffee

17. Mid Semester Examination

18. Pests of rose, jasmine, crossandra, chrysanthemum and tuberose
19. Pests of cashew, cocoa and betelvine
20. Pests of ginger, turmeric and coriander
21. Pests of cardamom, pepper and curry leaf
22. Structural entomology – their importance and classification - nature of damage and management of importance household pests
23. Factors affecting loss of stored grains - insect pests associated with stored grains – external feeder
24. Insect pests associated with stored grains – internal feeder – management of stored grain pests
25. Birds and microorganism associated with stored grains and their management

26. Mites and rodents associated with stored grains and their management
27. Storage structures and methods of grain storage - fundamental principles of stored grains management
28. Nature of damage and management of non-insects pests of crops - mites, snails and slugs
29. Concept of IPM, practices, scope and limitations of IPM
30. Classification of insecticides, toxicity of insecticides and formulations of insecticides
31. Biorational pesticides including insect repellents, antifeedants
32. Use of drones and AI in pest management.

Practical

Field visit, identification of major insect pests and their damage symptoms. Collection and preservation of major insect pests; collection of damage samples, their identification and herbarium preparation. Methods of monitoring of pest incidence in situ. Management strategies of insect pests of different crops. Study on structural entomology and household pests. Storage structures and methods of grain storage. Spraying techniques for selected field and horticultural crops. Vertebrate pest management, Mass multiplication of NPV and entomopathogenic nematodes.

Practical Schedule

1. Field visit, identification of major insect pests and their damage symptoms, collection and preservation of insect pests, herbarium preparation of damage samples of rice
2. Pests of maize, sorghum and ragi
3. Pests of pulses (blackgram, greengram, redgram and cowpea)
4. Pests of groundnut, sesame, castor and sunflower
5. Pests of cotton and sugarcane
6. Pests of mango, sapota, banana, citrus, grapevine, guava and pomegranate
7. Pests of brinjal, bhendi, tomato, crucifers and cucurbits
8. Pests of tea, coffee and coconut
9. Pests of rose, jasmine, cardamom and pepper
10. Methods of monitoring of pest incidence in situ
11. Management strategies of insect pests of different crops
12. Study on structural entomology and household pests
13. Storage structures and methods of grain storage
14. Spraying techniques for selected field and horticultural crops.
15. Vertebrate pest management
16. Mass multiplication of NPV, entomopathogenic fungi, entomopathogenic bacteria and entomopathogenic nematodes
- 17. Final Practical Examination**

Suggested Readings:

1. Atwal, A.S. 1986. Agricultural Pests of India and South East Asia. Kalyani Publishers. Ludhiana.
2. Dhaliwal, G.S. and Ramesh Arora. 2004. Integrated pest management Concepts and Approaches, Kalyani Publishers, New Delhi.
3. Prakash Rambhat Thalya and V. Ravi Chandra. 2022. Essentials of Pest Management: Key Information on Pest Identification and its Management, Wings Publication.
4. Somnath Sen and Mohd. Sameer. 2021. A Textbook of Insect Pest and Disease Management. S. Kataria and Sons publisher. New Delhi.
5. Srivastava, K.P. and G. S. Dhaliwal. 2010. A Textbook of Applied Entomology, Kalyani Publishers, New Delhi.
6. Tarique Hassan Askary. 2022. Pest Management: Methods, Applications and Challenges. Agriculture, Agriculture Issues and policies, Books, Nova, Pest Control, Science and Technology.

Course No.	:	AGR 301
Course Title	:	Introduction to Agro-meteorology
Credit Hours	:	1+1
Course Category	:	Core Course

Course Learning Rationale / Course Objectives (CLR):

The purpose of learning this course is:

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

Course Learning Outcome (CLO):

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

THEORY

Unit 1: Climate and weather

Meteorology - Agricultural Meteorology - 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

Unit 2: Solar radiation and Temperature

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

Unit 3: Atmospheric pressure and Wind

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

Unit 4: Atmospheric humidity, Precipitation and weather hazards

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

Unit 5: Weather forecasting and Climate change

Agro climatic normals - Weather forecasting – types-uses and its impact inAgriculture. Modifications of crop micro climate, climate normal for crop and livestock. Climate change- climate variability, global warming - definition and causes of climate change - Impact of climate change on Regional and national Agriculture.

Theory - Lecture Schedule

1. Meteorology - Agricultural Meteorology - Definition, their importance and scope in crop production. Coordinates of India and Tamil Nadu.
2. Atmosphere - Composition of atmosphere - Vertical layers of atmosphere based on temperature difference / lapse rate.
3. Climate and weather - Factors affecting climate and weather. 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.
11. Clouds and their classification - Concepts of cloud seeding - present status.
12. Precipitation - Forms of precipitation - Isohyets - Monsoon - Different monsoons of India - Rainfall variability
13. Evaporation - Transpiration, Evapotranspiration - Potential Evapotranspiration - Definition and their importance in agricultural production.
14. Weather hazards- Drought and flood – Extreme weather conditions- cold wave- heat wave-Impact on crop production.
15. Modifications of crop microclimate- climate normals for crop and livestock production.
16. Weather forecasting - Types, importance, Agro Advisory Services.
17. Climate change, global warming climate variability - definition and causes of climate change. Impact of climate change on Regional and national Agriculture.

Practical

Visit of Agrometeorological Observatory, site selection of observatory, exposure of instruments and weather data recording, Measurement of total, shortwave and long wave radiation, and its estimation using Planck's intensity law, Measurement of albedo and sunshine duration, computation of Radiation Intensity using BSS; Measurement of maximum and minimum air temperatures, its tabulation, trend and variation analysis, Measurement of soil temperature and computation of soil heat flux, Determination of vapour pressure and relative humidity, Determination of dew point temperature, Measurement of atmospheric pressure and analysis of atmospheric conditions, Measurement of wind speed and wind direction, preparation of wind rose, Measurement, tabulation and analysis of rain, Measurement of open pan evaporation and evapotranspiration, Computation of PET and AET, Use of synoptic charts, weather reports, weather forecasting-types and methods, crop weather calendar- Mapping of agro climatic zones of India & Tamil Nadu.

Practical Schedule

1. Visit to Agrometeorological observatory- Site selection and layout for Agromet Observatory.
2. Calculation of local time - Time of observation of different weather elements - Reviewing agromet registers.

3. Measurement of total, shortwave and long wave radiation and use of plank's law for radiation estimation.
4. Measurements of albedo- sunshine hours (sunshine recorder)
5. Measurement of maximum and minimum air temperatures-tabulation-analysis.
6. Measurement of soil temperature and grass minimum thermometers – soil heat flux.
7. Relative humidity measurements - use of wet and dry bulb thermometers –
8. Psychrometer- Hygrograph-Determination of vapour pressure determination-dew point temperature.
9. Measurement of atmospheric pressure - barograph - Fortein-s barometer – analysis of atmospheric conditions.
10. Measurement of wind direction and wind speed and conversion (KMPH, KNOT, and M/Sec.) – wind roses.
11. Measurement of rainfall - Ordinary and self-recording rain gauges
12. Measurement of Dew - dew gauge
13. Probability analysis of rainfall for crop planning.
14. Measurement of Evaporation - Open pan evaporimeter- application of evaporation data.
15. Computation of ET-AET- PET.
16. Mapping of agro climatic Zones of India and Tamil Nadu and its characterization.
17. **Final Practical Examination**

Suggested Readings:

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

Web-References:

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

Course No.	:	AGR 302
Course Title	:	Weed Management
Credit Hours	:	1+1
Course Category	:	Core Course

Course Learning Rationale / Course Objectives (CLR):

1. To teach students about principles of weed science
2. To impart practical knowledge of weed management in field and horticultural crops

Course Learning Outcome (CLO):

1. Understanding the concepts of weeds and their management
2. Knowing the basics of herbicides, their formulations and selectivity.
3. Knowledge on Basics of managing weeds in field and horticultural crops.

THEORY**Unit 1: Weeds and their characteristics**

Introduction to weeds, characteristics of weeds, their harmful and beneficial effects on ecosystem. Classification, reproduction and dissemination of weeds, crop-weed competition, factors of competition, factors affecting growth and development. Studies on weed seed bank, weed shifts.

Unit 2: Concepts of Weed management

Concepts of weed management: physical, cultural, chemical and biological; principles and methods, integrated weed management. Implements for weed control.

Unit 3: Herbicides and their formulations

Herbicide classification, concept of adjuvants, surfactants, herbicide formulation and their use, Nano herbicides, precision weed management; allelopathy and robotics in weed management

Unit 4: Herbicide selectivity

Mode of action of herbicides and selectivity phenomenon. Concept of herbicide mixture and utility in agriculture, Herbicide compatibility with agro-chemicals and their application, Herbicide resistance and its management.

Unit 5: Weed management in crops and cropping systems

Weed management in different field and horticultural crops; aquatic weed management, weed management in cropping systems. Weed management in organic/natural farming.

Theory - Lecture Schedule

1. Introduction to weeds - Definition and classification of weeds – based on relative position, origin, morphology, ontogeny, growth characteristics, habitat, ecological affinity to water and dependence on other plants.
2. Characteristics of weeds – harmful and beneficial effects of weeds on ecosystem.
3. Reproduction and dissemination of weeds.
4. Crop-weed competition, factors of competition, factors affecting growth and development.
5. Studies on weed seed bank and weed shifts.
6. Principles and methods of weed control.
7. Concepts of weed management – physical, cultural, chemical and biological.
8. Classification of herbicide.
9. **Mid Semester Examination**
10. Herbicide formulation and their use, concept of adjuvants and surfactants and Introduction to Nano herbicides.
11. Precision weed management, Allelopathy and robotics in weed management.
12. Mode of action of herbicides and selectivity phenomenon. Concept of herbicide mixture and utility in agriculture.
13. Herbicide compatibility with agro-chemicals and their application.
14. Herbicide resistance and its management.
15. Integrated weed management.
16. Weed management in field and horticultural crops, aquatic weed management.
17. Weed management in cropping systems and in organic/natural farming.

Practical

Techniques of weed preservation, weed identification. Study weeds in different situations. Weed survey and weed vegetation analysis. Biology of important weeds. Study of herbicide formulations and mixture of herbicide. Study methods of herbicide application, Herbicide application equipment- their parts, use, maintenance and calibration. Weed control implements, Calculation of herbicide doses and requirement, weed control efficiency and weed index, Phytotoxicity of herbicides, Weed management in fallow lands, Management of problematic, aquatic and parasitic weeds.

Practical Schedule

1. Techniques of weed preservation and weed identification.
2. Identification and study of wetland Weeds.
3. Identification and study of gardenland weeds.
4. Identification and study of dryland weeds.
5. Weed survey and weed vegetation analysis
6. Biology of *Echinochloa crusgalli*, *Cyperus rotundus*, *Cynodon dactylon*, *Parthenium hysterophorus* and *Eichhornia crassipes*.
7. Study of herbicide formulations and mixtures of herbicide.
8. Study on herbicide application methods.
9. Study of herbicide application equipment, their parts, uses, maintenance and calibration.
10. Study of weed control implements.
11. Calculation of herbicide doses and requirement.
12. Calculations on weed control efficiency and weed index.
13. Study of phytotoxicity symptoms of herbicides in different crops.
14. Management of weeds in fallow lands.
15. Management of problematic and parasitic weeds.
16. Management of aquatic weeds.
- 17. Final Practical Examination**

Suggested Readings:

1. Crafts, A.S. and Robbins, W.W. 1973. Weed Control. Tata McGraw-Hill Publishing Co. Ltd., New Delhi.
2. Gupta, O.P. 1984. Scientific Weed Management. Today and Tomorrow Printers and Publishers, New Delhi.
3. Gupta, O.P. 2015. Modern Weed Management. Agro Bios (India), Jodhpur.
4. Naidu, V.S.G.R. Handbook of Weed Identification. Directorate of Weed Research, Jabalpur.
5. Rajagopal, A., Aravindan, R. and Shanmugavelu, K.G. 2015. Weed management of Horticultural Crops. Agrobios (India), Jodhpur.
6. Ramamoorthy, K. and Subbian, P. Predominant Weed flora in hill –ecosystems. Agrobios (India), Jodhpur.
7. Rao, V.S. 2000. Principles of Weed Science. Oxford & IBH Publishing Co., New Delhi.
8. Subramanian, S., Mohammed Ali, A. and Jayakumar, R. 1991. All About Weed Control. Kalyani Publishers, Ludhiana.
9. Tadulingam, C. and Venkatnarayana, D. 1955. A Handbook of Some South Indian Weeds. Government Press, Madras.
10. Thakur, C. 1977. Weed Science. Metropolitan Book Co. Pvt. Ltd., New Delhi.
11. Das, T.K. 2011. Weed science: Basics and Applications, Jain brothers, New Delhi.
12. Jaganathan R. and Jayakumar, R. 2003. Weed Science Principles, Kalyani Publishers, New Delhi.

Course No.	:	CRP 301
Course Title	:	Fundamentals of Crop Physiology
Credit Hours	:	2+1
Course Category	:	Core Course

Course Learning Rationale / Course Objectives (CLR):

1. Understand plant-water relations, water potential, absorption, loss, and soil-plant-atmosphere interactions.
2. Learn mineral nutrition, nutrient transport, deficiency correction, and modern soil-less cultivation methods.
3. Comprehend photosynthesis, respiration pathways, pigment systems, and environmental effects on these processes.
4. Grasp plant growth, development, senescence, photoperiodism, vernalization, and their physiological regulation.
5. Study plant growth regulators, their physiological roles, and commercial applications in crop management.

Course Learning Outcome (CLO):

1. Explain plant-water relations and mechanisms regulating water absorption and loss in crops.
2. Identify essential nutrients, their transport, deficiency symptoms, and modern nutrition techniques.
3. Describe photosynthesis and respiration processes along with environmental influences on them.
4. Analyse plant growth, development, environmental responses, and reproductive adaptations.
5. Understand functions of plant growth regulators and their practical applications in agriculture.

THEORY

Unit 1: Plant-Water Relations - Water gain & Water loss

Definitions of plant and crop physiology, their importance, and relationship with other branches of crop science - diffusion, osmosis, and imbibition and their roles in plant-water relations. Concepts of field capacity, permanent wilting point, available soil moisture. Water potential and its components, along with mechanisms of active and passive water absorption and theories of ascent of sap. Water loss through transpiration and guttation and their physiological significance. The structure and function of stomata, including mechanisms of opening and closing. Water use efficiency, the role of transpiration, and the soil-plant-atmosphere continuum.

Unit 2: Mineral Nutrition

Essential and beneficial mineral elements, macro- and micronutrients their physiological functions, and criteria of essentiality. Nutrient Transport Mechanisms Passive and active, ion exchange theory deficiency symptoms, and correction measures. Physiological Disorders Foliar nutrition, root feeding, controlled environment cultivation and Modern soilless cultivation methods—including hydroponics, sand culture, and aeroponics. Soil-Plant Interactions: Rhizosphere biology-Plant microbe interaction-symbiotic and non-symbiotic association, mycorrhizae, root exudates and its types.

Unit 3: Photosynthesis

The plant cell structure and organelles with their physiological functions. The photosynthetic apparatus, chloroplast structure, and types of pigments including chlorophyll a and b. Quantum requirement, quantum yield, red drop, Emerson enhancement effect, and pigment systems I and II are explained. Light absorption by pigments, energy transfer, and the Hill reaction as the source of oxygen. Cyclic and non-cyclic photophosphorylation and the formation of ATP and NADPH. Detailed pathways such as the Calvin Cycle (C_3), the C_4 pathway (Hatch and Slack cycle), and the CAM pathway with their mechanisms and significance. The effects of environmental factors like light, CO_2 , O_2 , and temperature on photosynthesis.

Unit 4: Respiration, Growth & Development

Respiration processes, including glycolysis, Krebs cycle, electron transport chain, and factors affecting respiration, along with a comparison of aerobic and anaerobic respiration. Definition of growth, development, differentiation, and methods of measuring plant growth. Crop growth rate (CGR), relative growth rate (RGR), net assimilation rate (NAR), and their significance. Physiological and biochemical changes during senescence, the stay-green trait, and abscission. Photoperiodism, classification of plants, photoperiodic induction, and the role of phytochrome. Vernalization, devernialization, types of vernalization, and their relation to flowering and abscission.

Unit 5: Plant Growth Regulators and Their Applications

Auxins - their physiological roles in cell elongation, apical dominance, and root initiation, along with commercial uses of IAA, IBA, and NAA. Gibberellins' - roles in stem elongation, seed germination, bolting and cytokinins' - functions in cell division and delaying senescence, applications of GA_3 and kinetin. Absciscic acid's - involvement in dormancy, stress resistance, and stomatal closure. Ethylene - role in fruit ripening and senescence, commercial uses of ethephon and ABA. New plant growth regulators such as Brassinosteroids, salicylic acid, Jasmonates, and Strigolactones and their physiological roles and commercial applications.

Theory - Lecture Schedule

1. Introduction to plant and crop physiology: definitions, importance, and relationship with other branches of crop science.
2. Diffusion, osmosis, and imbibition: definitions, mechanisms, and their roles in plant-water relations.
3. Water potential: components and their significance in plant water movement.

4. Concepts of field capacity, permanent wilting point, and available soil moisture.
5. Mechanisms of water absorption: active and passive uptake by roots. Apoplast, symplast and transmembrane route of water movement
6. Theories of ascent of sap in plants. Water loss: transpiration and guttation, and their physiological importance.
7. Structure and function of stomata; mechanisms of stomatal opening and closing. Antitranspirants - types and examples
8. Water use efficiency and the role of transpiration in crop productivity. Soil-plant-atmosphere continuum and its significance in water relations.
9. Essential and beneficial mineral elements: macro- and micronutrients, their physiological functions, and criteria of essentiality.
10. Nutrient transport mechanisms: passive and active transport, and ion exchange theory.
11. Nutrient deficiency symptoms: identification and correction measures. Physiological disorders.
12. Foliar nutrition and root feeding: principles and applications. Modern soilless cultivation techniques: hydroponics, sand culture, and aeroponics.
13. Soil-plant interactions: Rhizosphere biology-Plant microbe interaction-symbiotic and non-symbiotic association, mycorrhizae, root exudates and its types.
14. Plant cell structure and organelles with emphasis on physiological functions related to photosynthesis.
15. Photosynthetic apparatus: chloroplast structure and pigment types including chlorophyll a and b.
16. Quantum requirement, quantum yield, red drop, and Emerson enhancement effect. Pigment systems I and II and their role in light absorption and energy transfer.

17. Mid Semester Examination

18. Hill reaction and oxygen evolution in photosynthesis. Cyclic and non-cyclic photophosphorylation: mechanisms and formation of ATP and NADPH.
19. Calvin Cycle (C_3 pathway): steps, enzymes, and significance. C_4 photosynthesis (Hatch and Slack cycle): mechanism and advantages.
20. CAM pathway: mechanism and ecological significance in arid environments.
21. Environmental factors affecting photosynthesis: light intensity, CO_2 concentration, oxygen, and temperature.
22. Plant respiration: glycolysis, Krebs cycle, and electron transport chain. Factors affecting respiration and comparison of aerobic and anaerobic respiration.
23. Definitions of growth, development, and differentiation; methods for measuring plant growth.
24. Growth analysis parameters: Crop Growth Rate (CGR), Relative Growth Rate (RGR), Net Assimilation Rate (NAR).
25. Physiological and biochemical changes during senescence, stay-green trait, and abscission.

26. Photoperiodism: classification of plants, photoperiodic induction, and role of phytochrome.
27. Vernalization and devernialization: types and significance in flowering and abscission.
28. Auxins: physiological roles in cell elongation, apical dominance, root initiation; commercial applications of IAA, IBA, and NAA.
29. Gibberellins: roles in stem elongation, seed germination, and bolting; Cytokinins: cell division and delaying senescence; applications of GA₃ and kinetin.
30. Absciscic acid: involvement in dormancy, stress resistance, and stomatal closure.
31. Ethylene: role in fruit ripening and senescence; commercial uses of ethephon and ABA.
32. New plant growth regulators: Brassinosteroids, Salicylic acid, Jasmonates, and Strigolactones — physiological roles and commercial applications.

Practical

Study on structure and distribution of stomata; Demonstration of imbibition, osmosis, plasmolysis, estimation of water potential, relative water content; Tissue test for mineral nutrients, identification of nutrient deficiency and toxicity symptoms in plant; Identification of nutrients by hydroponics; Estimation of photosynthetic pigments, rate of photosynthesis, respiration and transpiration; Plant growth analysis; Study on senescence and abscission, hormonal regulation of senescence; Demonstration of the effects of different PGRs on plants, Leaf anatomy of C₃ and C₄ plants.

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. Leaf anatomy of C₃ and C₄ plants
- 17. Final Practical Examination**

Suggested Readings:

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

Course No.	:	FOR 301
Course Title	:	Introductory Agro forestry
Credit Hours	:	1+1
Course Category	:	Core Course

Course Learning Rationale / Course Objective (CLR):

The purpose of learning this course is to:

1. Study Agroforestry as an alternative system of land use.
2. Explore different Agroforestry models for soil and water conservation.
3. Understand the ecological and management aspects of Agroforestry.
4. Gain hands-on experience in nursery management, propagation and agroforestry field practices.
5. Examine the socio-economic potential of Agroforestry systems in India.

Course Learning Outcomes (CLO):

1. Define and classify different agroforestry systems practiced in India.
2. Identify and manage Multipurpose Tree Species (MPTS) for agroforestry.
3. Analyze the ecological interactions and benefits of integrating trees, crops and livestock.
4. Apply techniques of nursery management and vegetative propagation.
5. Conduct design, diagnostic and evaluation studies for agroforestry projects.
6. Appreciate the socio-economic and environmental roles of agroforestry in sustainable land use.

THEORY**Unit 1: Introduction to Agroforestry**

Introduction and Classification of Agroforestry - Definition, scope and objectives of agroforestry- Classification of agroforestry systems – structural, functional, ecological, socio-economic- Potential of agroforestry in India and traditional systems- Prevailing agroforestry systems in different regions of India.

Unit 2: Multipurpose tree species

Multipurpose Tree Species (MPTS) and Ecological Interactions - Concept and definition of MPTS - Selection criteria for MPTS based on agro-climatic conditions - Common MPTS in India and their roles in agroforestry - Tree-crop interactions – competition, complementarity and nutrient recycling - Ecological significance of agroforestry – biodiversity, microclimate modification.

Unit 3: Role of Agroforestry

Soil and Water Conservation & Socio-economic Aspects - Role of agroforestry in soil and water conservation - Windbreaks and shelterbelts – objectives, design and implementation. - Agroforestry and watershed management - Socio-economic benefits – livelihood security, rural employment, fuelwood and fodder - Agroforestry for climate resilience and food security.

Unit 4: Silviculture Techniques of tree species

Silvicultural Practices and Tree Management - Definition and scope of silviculture - Propagation methods: seeds, coppicing, root suckers, cuttings, transplanting - Nursery management: bed preparation, watering, shading, hardening - Site factors, tree selection, crown and root characteristics, phenology, nutrient and water needs - Field handling, pruning, thinning, harvesting techniques.

Unit 5: Agroforestry models, D & D system

Agroforestry Models and Evaluation - Agroforestry models developed by ICAR-IGFRI, ICFRE - Horticulture-based and forage-based agroforestry systems - Natural and artificial regeneration - Design and Diagnostic Survey Methodology - Evaluation of Agroforestry systems in various agro-climatic zones.

Theory - Lecture Schedule

1. Introduction to Agroforestry – Definition, scope and objectives.
2. Classification of Agroforestry systems – Structural, functional, ecological, socio-economic.
3. Prevailing Agroforestry systems in India – Regional models and practices.
4. Multipurpose Tree Species (MPTS) – Concept, criteria for selection, ecological roles.
5. Important MPTS in India – Characteristics and utility.
6. Tree-crop interactions – Types of interactions; competition and complementarity.
7. Nutrient recycling in Agroforestry and ecological benefits.
8. Soil and water conservation through Agroforestry – mechanisms and examples.
9. **Mid Semester Examination**
10. Role of windbreaks and shelterbelts – design, advantages, examples.
11. Socio-economic importance of Agroforestry – rural livelihood, gender aspects.
12. Introduction to silviculture – definitions, scope and regeneration methods.
13. Propagation techniques for tree species – seeds, coppicing, root suckers, cuttings.

14. Nursery management – bed preparation, cultural practices, transplanting.
15. Management of tree species – site factors, phenology, growth requirements.
16. Agroforestry models developed by ICAR-IGFRI and ICFRE – forage- and horticulture-based.
17. Design and diagnostic surveys – assessment, evaluation, monitoring of agroforestry systems.

Practical

Identification of vegetables and spice crops and their seeds. Description of varieties. Propagation methods - rapid multiplication techniques - seed collection and extraction. Nursery raising. Direct seed sowing and transplanting. Study of morphological characters of different vegetables and spices. Fertilizers applications. Harvesting and post-harvest practices, Economics of vegetables and spices cultivation, visit to spice gardens.

Practical Schedule

1. Identification and classification of important tree species in agroforestry systems.
2. Measurement of tree growth parameters – height, diameter, volume estimation.
3. Study of environmental factors affecting agroforestry systems – light, moisture, temperature.
4. Methods of plant propagation – seeds, cuttings, grafting, budding (demo and hands-on).
5. Nursery bed preparation, soil mixture and sowing techniques.
6. Practice of vegetative propagation techniques – budding, grafting, layering.
7. Study of natural and artificial regeneration techniques.
8. Layout and planting design for agroforestry plantations – spacing and species selection.
9. Field practices – pruning, coppicing, pollarding techniques.
10. Diagnostic survey and documentation of an agroforestry field.
11. Evaluation of agroforestry models in different agro-climatic zones.
12. Assessment of compatibility between tree species and crops.
13. Visit to prevailing agroforestry systems in the local region.
14. Virtual or actual visit to ICAR-IGFRI/ICFRE to study model agroforestry systems.
15. Compilation of field/practical observations and
16. Preparation of a student report for assessment.
- 17. Final Practical Examination**

Suggested Readings:

1. Nair, P.K.R. 1993. *An Introduction to Agroforestry*. Kluwer Academic Publishers.
2. Chundawat, D.S. and Gautham, S.K. 2017. *Textbook of Agroforestry*. Oxford & IBH Publishing.

3. Parthiban, K.T., Krishnakumar, N. and Karthick, M. 2018. *Introduction to Forestry*. Scientific Publishers, Jodhpur.
4. Divya, M.P. and Parthiban, K.T. 2005. *Textbook on Social Forestry and Agroforestry*. Satish Serial Publishing, New Delhi.

Course No.	:	GPB 301
Course Title	:	Crop Improvement (<i>Kharif</i> crops) – I
Credit Hours	:	1+1
Course Category	:	Core Course

Course Learning Rationale / Course Objective (CLR):

1. Familiarize students with the origin, distribution, and genetic resources of important Kharif crops.
2. Understand the breeding objectives, methods, and achievements in improving yield, quality, and resistance to biotic and abiotic stresses.
3. Study the inheritance of important economic traits in Kharif crops through classical and molecular approaches.
4. Develop skills to analyze and evaluate breeding programs and cultivar performance.
5. Expose students to recent advances in biotechnology and genomics as applied to Kharif crop improvement.

Course Learning Outcome (CLO):

1. Identify the origin, distribution, and genetic diversity of major Kharif crops and their wild relatives.
2. Explain breeding objectives and methods adopted for yield improvement, stress resistance, and quality enhancement in Kharif crops.
3. Analyze the inheritance patterns of key agronomic traits and apply appropriate selection strategies in crop improvement programs.
4. Evaluate the performance of improved varieties and hybrids under different agro-climatic conditions.
5. Apply biotechnological tools and molecular markers in the genetic improvement and characterization of Kharif crops.

THEORY

Unit 1: Rice and Maize

Centres of origin, distribution of species, wild relatives in Rice and Maize; Plant genetic resources, its utilization and conservation, study of genetics of qualitative and quantitative characters; Important concepts of breeding self-pollinated, cross-pollinated and vegetatively propagated crops. Major breeding objectives and procedures including conventional and modern innovative approaches for development of hybrids and varieties

for yield, adaptability, stability, abiotic and biotic stress tolerance and quality (physical, chemical, nutritional); Ideotype concept, climate resilient crop varieties for future. Hybrid seed production technology.

Unit 2: Sorghum, Pearl millet and Ragi

Centres of origin, distribution of species, wild relatives in Sorghum, Pearl millet and Ragi; Plant genetic resources, its utilization and conservation, study of genetics of qualitative and quantitative characters; Important concepts of breeding self-pollinated, cross-pollinated and vegetatively propagated crops. Major breeding objectives and procedures including conventional and modern innovative approaches for development of hybrids and varieties for yield, adaptability, stability, abiotic and biotic stress tolerance and quality (physical, chemical, nutritional); Ideotype concept, climate resilient crop varieties for future. Hybrid seed production technology.

Unit 3: Pigeon pea, Urd bean, Mung bean, Soybean, Groundnut, Sesame and Castor

Centres of origin, distribution of species, wild relatives in Pigeon pea, Urd bean, Mung bean, Soybean, Groundnut, Sesame and Castor; Plant genetic resources, its utilization and conservation, study of genetics of qualitative and quantitative characters; Important concepts of breeding self-pollinated, cross-pollinated and vegetatively propagated crops. Major breeding objectives and procedures including conventional and modern innovative approaches for development of hybrids and varieties for yield, adaptability, stability, abiotic and biotic stress tolerance and quality (physical, chemical, nutritional); Ideotype concept, climate resilient crop varieties for future. Hybrid seed production technology.

Unit 4: Cotton, Jute and Tobacco

Centres of origin, distribution of species, wild relatives in Cotton, Jute and Tobacco; Plant genetic resources, its utilization and conservation, study of genetics of qualitative and quantitative characters; Important concepts of breeding self-pollinated, cross-pollinated and vegetatively propagated crops. Major breeding objectives and procedures including conventional and modern innovative approaches for development of hybrids and varieties for yield, adaptability, stability, abiotic and biotic stress tolerance and quality (physical, chemical, nutritional); Ideotype concept, climate resilient crop varieties for future. Hybrid seed production technology.

Unit 5: Cowpea, Okra, Brinjal and Cucurbits

Centres of origin, distribution of species, wild relatives in Cowpea, Okra, Brinjal and Cucurbits; Plant genetic resources, its utilization and conservation, study of genetics of qualitative and quantitative characters; Important concepts of breeding self-pollinated, cross-pollinated and vegetatively propagated crops. Major breeding objectives and procedures including conventional and modern innovative approaches for development of hybrids and varieties for yield, adaptability, stability, abiotic and biotic stress tolerance and quality (physical, chemical, nutritional); Ideotype concept, climate resilient crop varieties for future. Hybrid seed production technology.

Theory - Lecture Schedule

- 1-2. Crop Improvement in Rice
3. Crop improvement in Maize
4. Crop improvement in Sorghum
5. Crop Improvement in Pearl millet and Ragi
6. Crop improvement in Pigeon pea, Urd bean and Mung bean
7. Crop improvement in Soybean and Cowpea.
8. Crop Improvement in Groundnut

9. Mid semester Examination

10. Crop improvement in Sesame and Castor
11. Crop improvement in Cotton
12. Crop improvement in Jute
13. Crop improvement in Tobacco
14. Crop improvement in Cowpea
15. Crop improvement in Brinjal
16. Crop improvement in Okra
17. Crop improvement in Cucurbits

Practical

Botany of crops, Floral biology, emasculation and hybridization techniques in different crop species, viz. rice, maize, sorghum, pearl millet, ragi, pigeon pea, urd bean, mung bean, soybean, groundnut, sesame, castor, cotton, Jute, cowpea, tobacco, brinjal, okra and cucurbitaceous crops. Maintenance breeding of different kharif crops. Handling of germplasm and segregating populations by different methods like pedigree, bulk and single seed decent methods; Study of field techniques for seed production and hybrid seed production in kharif crops; Estimation of heterosis, inbreeding depression and heritability; Layout of field experiments; Study of quality characters, donor parents for different characters; Visit to seed production plots; Visit to AICRP breeding plots of different crops.

Practical Schedule

1. Botany of crops, Floral biology, emasculation and hybridization techniques in Rice
2. Botany of crops, Floral biology, emasculation and hybridization techniques in Maize
3. Botany of crops, Floral biology, emasculation and hybridization techniques in Sorghum
4. Botany of crops, Floral biology, emasculation and hybridization techniques in Pearl millet and Ragi
5. Botany of crops, Floral biology, emasculation and hybridization techniques in Pigeon pea, Urd bean and Mung bean
6. Botany of crops, Floral biology, emasculation and hybridization techniques in Groundnut, Soybean and Cowpea

7. Botany of crops, Floral biology, emasculation and hybridization techniques in Sesame
8. Botany of crops, Floral biology, emasculation and hybridization techniques in Castor
9. Botany of crops, Floral biology, emasculation and hybridization techniques in Cotton
10. Botany of crops, Floral biology, emasculation and hybridization techniques in Jute
11. Botany of crops, Floral biology, emasculation and hybridization techniques in Tobacco
12. Botany of crops, Floral biology, emasculation and hybridization techniques in Brinjal
13. Botany of crops, Floral biology, emasculation and hybridization techniques in Okra
14. Botany of crops, Floral biology, emasculation and hybridization techniques in Cucurbits
15. Visit to Seed production plots of Kharif crops
16. Visit to AICRP breeding trials of different Kharif crops
- 17. Final Practical Examination**

Suggested Readings:

1. Breeding field crops -I by V.L. Chopra
2. Genetic improvement of field crops by C.B. Singh and D. Khare
3. Genetics and Breeding of Pulse crops by D.P. Singh
4. Vegetable breeding – Principles and Practices by Hari Har Ram
5. Breeding field crops by D.A. Sleper and J.M. Poehlman
6. Plant Breeding –theory and practice by S.K. Gupta 92 2(1+1)
7. Breeding Asian field crops by J.M. Poehlman and D.N. Barthakur
8. Practical manuals on Crop Improvement I (Kharif crops) by Rajendra Kumar Yadav.

Course No.	:	HOR 311
Course Title	:	Ornamental Crops, MAPs and Landscaping
Credit Hours	:	1+1
Course Category	:	Core Course

Course Learning Rationale / Course Objective (CLR):

The purpose of learning this course is to:

1. To educate in detail about origin, area, climate, soil, improved varieties production technology of flowers and MAPs

2. To educate about concept, designing principles and components of landscaping
3. To educate about the physiological disorders of commercial flowers
4. To educate about the post-harvest management and value addition in flower crops and MAP.

Course Learning Outcomes (CLO):

1. Explain the importance of ornamental crops, MAPs and landscaping.
2. Describe the principles of landscaping, features of gardens and landscape uses of plants.
3. Explain the production technology of ornamental crops and value addition.
4. Explain the production technology of medicinal & aromatic plants and value addition.

THEORY

Unit 1: Introduction

Importance and scope of ornamental crops, medicinal and aromatic plants, and landscaping.

Unit 2: Landscaping

Principles of landscaping; Landscape uses of trees, shrubs and climbers, Brief concept of home landscaping, carpet bedding, topiary, bonsai, lawn, flower arrangement, herbaceous border, hedge, edge *etc.*

Unit 3: Features of gardens

Features of gardens such as carpet bedding, topiary, bonsai, lawn, flower arrangement, herbaceous border, hedge, edge *etc.*

Unit 4: Production Technology of ornamental crops and value addition

Production technology of important cut flowers like rose, gerbera, chrysanthemum, carnation, anthurium, orchids, gladiolus, tuberose and liliun; Package of practices for loose flowers like marigold and jasmine under open conditions; Processing and value addition in important ornamental crops

Unit 5: Production technology of medicinal and aromatic plants and value addition

Production technology of ashwagandha, costus, isabgol, aloe, coleus, glory lily, periwinkle, asparagus, senna, guggul, mint, ocimum, geranium, lemongrass, citronella, vetiver and palmarosa, Processing and value addition of MAPs produce.

Theory - Lecture Schedule

1. Importance and scope of ornamental crops, medicinal and aromatic plants, and landscaping.
2. Principles of landscaping and brief concept of home landscaping.
3. Landscape uses of trees, shrubs and climbers.

4. Features of gardens such as carpet bedding, topiary, bonsai, lawn, flower arrangement, herbaceous border, hedge, edge, *etc.*
5. Production technology of cut flowers: Rose and Gerbera.
6. Production technology of cut flowers: Chrysanthemum and Carnation.
7. Production technology of cut flowers: Anthurium, Liliun and Orchids.
8. Production technology of cut flowers: Gladiolus and Tuberose.

9. Mid Semester Examination

10. Package of practices for loose flower cultivation under open conditions: Marigold and Jasmine.
11. Processing and value addition in important ornamental crops.
12. Production technology of medicinal plants: Ashwagandha and Isabgol.
13. Production technology of medicinal plants: Aloe, Coleus, Glory lily and Periwinkle.
14. Production technology of medicinal plants: Asparagus, Senna, Guggul and Costus.
15. Production technology of aromatic plants: Lemongrass, Citronella, Palmarosa and Vetiver.
16. Production technology of aromatic plants: Mint, Ocimum and Geranium.
17. Processing and value addition of MAPs produce.

Practical

Identification MAPs and Ornamental plants (trees, shrubs, climbers, seasonal flower and house plants). Propagation of MAP, Bed preparation and planting of MAP; Nursery bed preparation and sowing of seasonal flower seeds; Propagation of ornamental plants by terminal/herbaceous cuttings; Propagation of Anthurium and orchids; Propagation of bougainvillea; Planting of gerbera suckers; Gladiolus corms; Establishment and maintenance of lawn; Preparation of flower preservatives and their use in extending the vase life of cut flowers; Training and pruning of ornamental plants and raising of hedge and edge; Planning and layout of garden.

Practical Schedule

1. Identification of medicinal plants
2. Identification of aromatic plants
3. Identification of ornamental plants (trees, shrubs, climbers, seasonal flowers and house plants)
4. Propagation of MAPs
5. Bed preparation and planting of MAPs
6. Nursery bed preparation and sowing of seasonal flower seeds
7. Propagation of ornamental plants by terminal/herbaceous cuttings
8. Propagation of Anthurium and orchids
9. Propagation of bougainvillea
10. Planting of gerbera suckers and gladiolus corms
11. Establishment and maintenance of lawn

12. Preparation of flower preservatives and their use in extending the vase life of cut flowers.
13. Training and pruning of ornamental plants
14. Raising of hedge and edge
15. Planning and layout of garden
16. Processing of MAPs
17. **Final Practical Examination**

Suggested Readings:

1. Arora, J. S. 2010. Introductory Ornamental Horticulture. Kalyani Publisher.
2. Aswath, C., T.K. Bose, R. Bhatia, K. Dutta, R. Kumar and S.N. Saha. 2021. Commercial Flowers (Vol.1 & 2, 3rd Rev. Edn.). Astral Publishing.
3. Bose, T. K., Malti, R. G., Dhua, R. S. and Das, P. 2012. Floriculture and Landscaping (Vol. 1&2, 2nd Rev. Edn.). Nayaprakash.
4. Chadha, K.L. 2019. Handbook of Horticulture (2 Vol., 2nd Rev. Edn.). ICAR, New Delhi.
5. Kumar, N. 2017. Introduction to Spices, Plantation Crops, Medicinal & Aromatic Plants (3rd Edn.). MedTech.
6. Randhawa, G. S. and A. Mukhopadhyay. 2004. Floriculture in India. Allied Publishers.
7. Singh, A.K. and Anjana Sisodia. 2017. Textbook of Floriculture and Landscaping. NIPA.

Course No.	:	PAT 301
Course Title	:	Diseases of Field and Horticultural Crops and their Management
Credit Hours	:	2+1
Course Category	:	Core Course

Course Learning Rationale / Course Objective (CLR):

1. To study the etiology and symptoms of major plant diseases infecting field and horticultural crops.
2. To know about the mode of survival, spread and disease cycle of major plant pathogens infecting field and horticultural crops.
3. To study the epidemiological factors responsible for disease development.
4. To study the integrated disease management (IDM) strategies for curbing the major diseases of field and horticultural crops.

Course Learning Outcomes (CLO):

1. Acquire skill to identify disease etiology and accurately differentiate disease symptoms through visual diagnosis and microscopic examination of pathogens.

2. Understand the mode of survival, mechanisms of dissemination and disease cycles of major plant pathogens infecting field and horticultural crops.
3. Gain in-depth knowledge of key epidemiological factors influencing disease development and progression, enabling prediction and timely intervention.
4. Develop the expertise to formulate and recommend crop-specific integrated disease management (IDM) strategies for effective and sustainable disease management.

THEORY

Symptoms, etiology, mode of spread, survival, epidemiology and integrated disease management (IDM) strategies for important diseases of field and horticultural crops.

Unit 1: Diseases of cereals and millets

Cereals: Rice - Blast, brown spot, sheath rot, sheath blight, false smut, bacterial leaf blight, bacterial leaf streak, tungro, rice yellow dwarf and khaira, Wheat - Stem rust, leaf rust, stripe rust, loose smut, karnal bunt, hill bunt, flag smut, powdery mildew, tundu disease and wheat streak mosaic virus, Maize - Downy mildews, banded leaf and sheath blight, southern and northern blights, smut, charcoal rot, stalk rot and corn stunt.

Millets: Sorghum - Downy mildew, smuts, grain mold, anthracnose, rust and witch weed / striga, Bajra - Downy mildew, ergot and rust, Finger millet - Blast and leaf blight.

Unit 2: Diseases of pulses and oilseeds

Pulses: Pigeonpea - Wilt, root rot, powdery mildew, stem blight and sterility mosaic, Black gram and Green gram - Dry root rot, powdery mildew, Cercospora leaf spot, anthracnose, rust, yellow mosaic and leaf crinkle, Bengal gram - Wilt, Ascochyta blight, rust and grey mold, Soybean - Purple speck, downy mildew, frog eye spot, bud blight, bacterial spot and mosaic.

Oilseeds: Groundnut - Early and late leaf spot, rust, collar rot, yellow mould, root rot, bud necrosis and peanut stunt, Sesame - Alternaria blight, powdery mildew and phyllody, Castor – Rust, Sunflower: Downy mildew, Sclerotinia stem rot, rust, powdery mildew, head rot, Alternaria blight and sunflower necrosis disease, Mustard: Alternaria blight, white rust and downy mildew.

Unit 3: Diseases of cash crops and fruit crops

Cash Crops: Sugarcane - Red rot, smut, sett rot, wilt, ratoon stunting, grassy shoot, yellow leaf syndrome and Pokkah boeng, Cotton - Fusarium wilt, Verticillium wilt, root rot, anthracnose, grey mildew, boll rot, bacterial blight and leaf curl.

Fruit Crops: Mango - Anthracnose, malformation, powdery mildew, die- back and stem end rot, sooty mould, grey blight, bacterial canker, red rust, loranthus and black tip, Banana - Panama wilt, sigatoka leaf spot, anthracnose, moko wilt, rhizome rot, Bunchy top and streak mosaic, Citrus - Gummosis, scab, canker, greening, stubborn, tristeza and exocortis, Grapevine - Downy mildew, powdery mildew, anthracnose, rust, black rot, grapevine fan leaf

and pierce's disease, Guava – Wilt, Papaya - Foot rot, leaf curl, mosaic and ring spot, Jack - Fruit rot, Pomegranate - Bacterial blight, Pineapple - Heart rot, Apple - Scab, powdery mildew, fire blight and crown gall, Peach - Leaf curl. Plum: Plum pocket, Post-harvest diseases of fruits.

Unit 4: Diseases of vegetable and spice crops

Vegetable Crops: Tuber crops – Potato - Late blight, black scurf, common scab, brown rot, wart, leaf roll and mosaic, Sweet Potato - Black rot, Cassava – Mosaic, Tomato - Damping off, wilt, early blight, bacterial wilt, bacterial leaf spot, spotted wilt, leaf curl and mosaic, Brinjal - Phomopsis blight, bacterial wilt and little leaf. Okra - Wilt, powdery mildew and yellow vein mosaic, Cucurbits - Wilt, powdery mildew, downy mildew, leaf spot, anthracnose and cucumber mosaic, Cruciferous vegetables - White rust, Damping off/ wire stem, club root, Alternaria leaf spot, black rot, downy mildew and cauliflower mosaic, Beans and Peas - Anthracnose, common blight, halo blight, rust and common mosaic, Peas - Wilt and Ascochyta blight, Post-harvest diseases of vegetables,

Spice crops: Chilli - Anthracnose and fruit rot, powdery mildew, bacterial leaf spot and leaf curl, Onion - Purple blotch, smut, smudge and soft rot, Ginger - Soft rot, Turmeric - Rhizome rot, leaf spot, leaf blotch and bacterial wilt, Coriander - Stem gall, Cardamom - Capsule rot, rhizome rot, katte disease, Cardamom Vein Clearing, Foorkey disease and Chirkey disease.

Unit 5: Diseases of plantation, ornamental crops and medicinal crops

Plantation Crops: Coconut - Bud rot, Ganoderma wilt, stem bleeding, grey blight, root wilt, Cadang-Cadang and pencil point. Arecanut - Mahali disease/bud rot and foot rot, Black pepper - Quick wilt, pollu disease and slow decline. Tea: Blister blight and root diseases, Coffee – Rust, Rubber - Abnormal and secondary leaf fall, Cocoa - Black pod rot and swollen shoot.

Ornamental crops: Rose - Dieback, powdery mildew, rust, petal fire and black spot, Jasmine - Leaf blight, Crossandra - Wilt, Chrysanthemum - Leaf spot, grey mould and stunt, Marigold - Aster yellows.

Medicinal crops: Gloriosa - Leaf blight and root rot, Coleus - Damping off and downy mildew, Stevia - Leaf blight and stem rot, Aloe vera - Anthracnose, leaf spot and bacterial soft rot.

Theory – Lecture Schedule

Symptoms, etiology, mode of spread, survival, epidemiology and integrated disease management (IDM) strategies for

1. Diseases of Rice.
2. Diseases of Wheat.
3. Diseases of Maize.
4. Diseases of Sorghum, bajra and finger millet.
5. Diseases of Pigeonpea, black gram and green gram.
6. Diseases of Bengal gram and soybean.

7. Diseases of Groundnut, sesame and castor
8. Diseases of Sunflower and mustard.
9. Diseases of Sugarcane.
10. Diseases of Cotton.
11. Diseases of Mango.
12. Diseases of Banana.
13. Diseases of Citrus.
14. Diseases of Grapevine.
15. Diseases of Guava, papaya, jack, pomegranate and pineapple.
16. Diseases of Apple, peach and plum.
17. **Mid Semester Examination**
18. Post-harvest diseases of fruits.
19. Diseases of Potato, sweet potato and cassava.
20. Diseases of Tomato.
21. Diseases of Brinjal and okra.
22. Diseases of Cucurbits.
23. Diseases of Cruciferous vegetables.
24. Diseases of Beans and peas.
25. Post-harvest diseases of vegetables.
26. Diseases of Chilli and onion.
27. Diseases of Ginger, turmeric and coriander.
28. Diseases of Cardamom.
29. Diseases of Coconut and arecanut.
30. Diseases of Black pepper, tea, coffee, rubber and cocoa.
31. Diseases of Rose, jasmine crossandra, chrysanthemum and marigold.
32. Diseases of Gloriosa, coleus, stevia and aloe vera.

Practical

Study of symptoms and host parasite relationship of rice, wheat, maize, sorghum, bajra, finger millet, pigeon pea, black gram and green gram, bengal gram, soybean, groundnut, sesame, castor sunflower, mustard, sugarcane, cotton, mango, banana, citrus, grapevine, guava, papaya, pomegranate, jack, pineapple apple, peach, plum, post-harvest diseases of fruits, potato, sweet potato, cassava, tomato, brinjal, okra, cucurbits, cruciferous vegetables, beans, peas, post-harvest diseases of vegetables, chilli, onion, ginger, turmeric, coriander, cardamom, coconut, Arecanut, tea, coffee, black pepper, rubber, cocoa, rose, jasmine, crossandra, chrysanthemum, marigold.

Practical Schedule

Identification of diseases of the following crops by observing symptoms in the field and microscopic examination of pathogens to understand their interaction with the host plants.

1. Diseases of cereals – Rice and wheat.
2. Diseases of millets – Maize, sorghum, bajra and finger millet.

3. Diseases of pulses – Pigeonpea, blackgram, green gram, bengal gram and soybean.
4. Diseases of oil seeds – Groundnut, sesame, castor, sunflower and mustard.
5. Diseases of cash crops – Sugarcane and cotton.
6. Diseases of tropical fruit crops – Mango, banana and citrus.
7. Field visit for the diagnosis of disease symptoms and collection of diseased plant specimens for preservation as herbarium.
8. Diseases of tropical fruits crops – Grapevine, guava, papaya, pomegranate, jack and pineapple.
9. Diseases of pome fruit crops – Apple, peach and plum.
10. Diseases of solanaceous vegetables – Tomato, brinjal and okra.
11. Diseases of Tuber crops – Potato, sweet potato and cassava.
12. Diseases of cucurbits and cruciferous vegetables.
13. Diseases of beans, peas, chilli and onion.
14. Diseases of spices – Black pepper, ginger, turmeric, coriander and cardamom.
15. Diseases of plantation crops – Coconut, arecanut, tea, coffee, rubber and cocoa.
16. Diseases of flower crops – Rose, jasmine, chrysanthemum, crossandra and marigold.
17. **Final Practical Examination**

Assignment: Submission of 50 well preserved diseased specimens during the semester.

Suggested Readings:

1. Richard Oliver, 2024. Agrios's Plant Pathology. Academic Press, New York.
2. Rangasawmi, G and Mahadevan, A. 2022. Diseases of crop Plants in India, PHI Learning Pvt. Ltd., New Delhi.
3. Thind. T.S. 2022. Diseases of Field and Horticultural Crops and Their Management. New India Publishing Agency (NIPA), New Delhi.
4. Chaube, H.S. and V.S. Pundhir. 2005. Crop Diseases and Their Management. PHI Learning Pvt. Ltd., New Delhi.
5. Prakasam, V., Valluvaparidasan, V., Raguchander, T. and K. Prabakar. 1997. Field crop diseases, AE Publication, Coimbatore.
6. Parthasarathy, S., Thiribhuvanamala, G. and K. Prabakar. 2020. Diseases of Field Crops and their Management. CRC Press, London.
7. Arjunan G., Dinakaran, S. and S. Parthasarathy. 2022. Diseases of Horticultural Crops and their Management. Daya Publishing House, New Delhi.
8. Arjunan. G., Dinakaran, D. and S. Parthasarathy. Diseases of Horticultural Crops.

Web- References:

1. www.apsnet.org
2. www.plantdisease.com
3. <https://niphm.gov.in>
4. www.farmers.gov.in
5. www.ecourses.icar.gov.in

Course No.	:	MDC 301
Course Title	:	Agricultural Marketing and Trade
Credit Hours	:	2+1
Course Category	:	Multi-Disciplinary Course

Couse Learning Rationale/ Course Objective (CLR):

The purpose of learning this course is:

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

Couse Learning Outcomes (CLO):

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

THEORY

Unit 1: Agricultural Marketing and Marketing Forces

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

Unit 2: Pricing and Promotion Strategies and Marketing Functions

Pricing and promotion strategies: pricing considerations and approaches – cost based and competition based pricing; market promotion – advertising, personal selling, sales promotion and publicity – meaning, merits and demerits; marketing process and functions: Marketing process concentration, dispersion and equalization; exchange functions – buying and selling; physical functions – storage, transport and processing; facilitating functions – packaging, branding, grading, quality control and labelling (AGMARK).

Unit 3: Marketing Efficiency and Marketing Costs

Market functionaries and marketing channels: Types and importance of agencies involved in agricultural marketing; meaning and definition of marketing channel; number of channel levels; marketing channels for different farm products; Integration, efficiency, costs and price spread: Meaning, definition and types of market integration; marketing efficiency; marketing costs, margins and price spread; factors affecting cost of marketing; reasons for higher marketing costs of farm commodities; ways of reducing marketing costs.

Unit 4: Marketing Institutions and Risk in Marketing

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

Unit 5: Agricultural Prices and Trade in Agricultural Products

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

Theory - Lecture Schedule

1. Agricultural Marketing: Concepts and definitions of market, marketing, and agricultural marketing.
2. Classification and characteristics of agricultural markets.
3. Market Structure: Meaning, Components, and Price determination under perfect and imperfect competition.
4. Marketing mix and Market segmentation: Meaning, Components.
5. Demand, supply of agri commodities: nature and determinants of demand and supply of farm products.
6. Producer's surplus – meaning and its types, marketable and marketed surplus, factors affecting marketable surplus of agri commodities.
7. Product Life Cycle (PLC) and competitive strategies: Meaning and stages in PLC; characteristics of PLC; strategies in different stages of PLC.
8. Pricing strategies: pricing considerations and approaches – cost- and competition-based pricing.
9. Promotion strategies: market promotion – advertising, personal selling, sales promotion, and publicity – meaning, merits, and demerits.
10. Marketing process and functions: Marketing process concentration, dispersion, and equalization.
11. Exchange functions – buying and selling; Physical functions – storage, transport, and processing.
12. Facilitating functions – packaging, branding, grading, quality control, and labelling (AGMARK).

13. Market functionaries: Types and importance of agencies involved in agricultural marketing.
14. Marketing channels: Meaning and definition of marketing channel; number of channel levels; marketing channels for different farm products.
15. Market Integration: Meaning, definition, and types of market integration.
16. Marketing Efficiency and price spread: marketing efficiency, margins and price spread.

17. Mid Semester Examination

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

Practical

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

Practical Schedule

1. Preparation of farm survey schedule
2. Visit to farm to collect information on marketing practices of agricultural commodities
3. Plotting and study of demand and supply curves and calculation of elasticities.
4. Computation of marketable and marketed surplus of important commodities.
5. Study of the relationship between market arrivals and prices of some selected commodities.
6. Study of price behaviour over time for some selected commodities.
7. Construction of index numbers.
8. Identification of marketing channels for selected commodities, collection of data regarding marketing costs, margins and price spread and presentation of report in the class.
9. Visit to a local market/ farmers' market to study various marketing functions performed by different agencies.
10. Visit to market committee and regulated market to study their organization and functioning.
11. Visit to market institutions – NAFED to study their organization and functioning.
12. Visit to market institutions – SWC/CWC to study their organization and functioning.
13. Visit to market institutions – Cooperative marketing society to study their organization and functioning.
14. Visit to Farm input dealer to study the marketing of farm inputs.
15. Visit to Commodity Boards / AEZ / Export oriented units.
16. Application of principles of comparative advantage of international trade.
17. **Final Practical Examination**

Suggested Readings:

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

Course No.	:	PJN 301
Course Title	:	Educational Tour
Credit Hours	:	0+2
Course Category	:	Non Gradiual course

Syllabus

Visit to important National and International institutes related to agriculture, horticulture, forestry and allied fields in various regions of the country outside the state. 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. The duration of the course will be 10-14 days inclusive of onward and return journey.

VI SEMESTER

Sl.No.	Course No.	Course Title	Discipline	Cr.Hr.
1.	AEC 301	Agricultural Finance & Cooperation	AEC	1+1
2.	AEG 301	Renewable Energy in Agriculture and Allied Sector	AEG	1+1
3.	AGM 301	Agricultural Microbiology and Phyto-remediation	AGM	1+1
4.	AGR 303	Rainfed Agriculture and Watershed Management	AGR	1+1
5.	BIC 301	Essentials of Plant Biochemistry	SAC	2+1
6.	GPB 302	Crop Improvement (<i>Rabi</i> crops) - II	PBG	1+1
7.	GPB 303	Fundamentals of Agricultural Biotechnology	PBG	2+1
8.	SST 301	Fundamentals of Seed Science & Technology	SST	1+1
9.	STA 301	Basic and Applied Agricultural Statistics	STA	2+1
		TOTAL		12+9=21

Course No.	:	AEC 301
Course Title	:	Agricultural Finance & Cooperation
Credit Hours	:	1+1
Course Category	:	Core Course

Course Learning Rationale / Course Objective (CLR):

The purpose of learning this course is to:

1. Expose the students on agricultural finance
2. Understand the Agriculture Finance institutions
3. Exposure on Farm finance analysis
4. Recognize co-operations and cooperation institutions
5. Understand monetary policies and non-banking financial institutions and Insurance for crops

Course Learning Outcomes (CLO):

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

1. Apply the financial activity in farming
2. Compare approaches to avail projects and funding
3. Understand the financial products in banks
4. Describe Agriculture cooperative banks and regional rural banks
5. Summarize the credit gaps and Agriculture insurances

THEORY

Unit 1 Agricultural finance – Nature & 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 - Credit analysis: 4 R's, 7 Ps and 3C's of credit. Sources of agricultural finance: institutional and non-institutional sources and their roles.

Unit 2 Financial Institutions

Commercial banks - social control and nationalization of commercial banks. Micro financing including KCC, Micro finance – Lead Bank Scheme, RRBs, Scale of finance and unit cost. An introduction to higher financing institutions – RBI, NABARD, ADB, IMF, World Bank, Insurance and Credit Guarantee Corporation of India. Cost of credit - Recent development in agricultural credit.

Unit 3 Farm financial analysis

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. 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; role of ICA, NCUI, NCDC, NAFED. Successful cooperative systems in Gujarat (AMUL), Tamil Nadu (Aavin), Karnataka (Nandini), Maharashtra and Punjab.

Unit 5 Banking & Insurance

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. 'Pradhan Mantri Fasal Bima Yojana'.

Theory - Lecture Schedule

1. Agricultural Finance- meaning, scope and significance, credit needs and its role in Indian agriculture.
2. Agricultural credit: meaning, definition, need, classification. Sources of credit - advantages and disadvantages.
3. Credit analysis: 4 R's, 7 Ps and 3C's of credit. Sources of agricultural finance: institutional and non-institutional sources and their roles.
4. Commercial banks - social control and nationalization of commercial banks. Cost of credit - Recent development in agricultural credit.
5. Micro financing including KCC, Micro finance – Lead Bank Scheme, RRBs, Scale of finance and unit cost.
6. An introduction to higher financing institutions – RBI, NABARD, ADB, IMF, World Bank, Insurance and Credit Guarantee Corporation of India.
7. Preparation and analysis of financial statements – Balance Sheet, Income Statement and Cash Flow Statement.
8. Basic guidelines for preparation of project reports - Bank norms
9. **Mid Semester Examination**
10. SWOT analysis.
11. Agricultural Cooperation in India – Meaning, brief history of cooperative development in India. Co-operating credit structure: short term and long term.
12. Agricultural Cooperation - credit, marketing, consumer and multi-purpose cooperatives, farmers' service cooperative societies, processing cooperatives, farming cooperatives, cooperative warehousing;
13. Role of ICA, NCUI, NCDC, NAFED.
14. Successful cooperative systems in Gujarat (AMUL), Tamil Nadu (Aavin), Karnataka (Nandini), Maharashtra and Punjab.

15. Crop Insurance: Schemes, Coverage, Advantages and Limitations in Implementation
16. Weather based crop insurance, features, determinants of compensation.
17. Livestock Insurance Schemes Agricultural Insurance Company of India Ltd (AIC): Objectives and functions. 'Pradhan Mantri Fasal Bima Yojana'.

Practical

Optimum allocation of limited amount of capital among different enterprise. Analysis of progress and performance of cooperatives using published data. Analysis of progress and performance of commercial banks and RRBs using published data. Visit to a commercial bank, cooperative bank and cooperative society to acquire first-hand knowledge of their management, schemes and procedures. Estimation of credit requirement of farm business – A case study. Preparation and analysis of balance sheet – A case study. Preparation and analysis of income statement – A case study. Appraisal of a loan proposal – A case study. Techno-economic parameters for preparation of projects. Preparation of Bankable projects for various agricultural products and its value-added products. Seminar on selected topics. Different types of repayment plans.

Practical Schedule:

1. Determination of most profitable level of capital use.
2. Optimum allocation of limited amount of capital among different enterprise.
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, to acquire first- hand knowledge of their management, schemes and procedures.
6. Visit to a cooperative bank / cooperative society to acquire first- hand knowledge of their management, schemes and procedures
7. Estimation of credit requirement of farm business – A case study.
8. Preparation and analysis of Balance Sheet and Income Statement.
9. 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. Estimation of Undiscounted methods
13. Estimation of discounted methods.
14. Preparation of bankable projects for various agricultural products and its value added products.
15. Different types of repayment plans
16. Seminar on selected topics.
- 17. Final Practical Examination.**

Suggested Readings:

1. Bhagat, D. (2014). Textbook of Agricultural Marketing and Co-operation. India: Neha Publishers & Distributors. pp. 2-66
2. Reddy, S, S., (2017). Agricultural Finance and Management. New Delhi: Oxford & IBH Publishing. pp 1-268
3. Charles Moss, B. (2013). Agricultural Finance.UK: Routledge Company. pp. 1-295.
4. Geman,H (2015). Agricultural Finance: From Crops to Land, Water and Infrastructure (The Wiley Finance Series), USA: WileyPublishers.pp.1-288
5. Gittinger, J.P. 1982. Economic Analysis of Agricultural Projects. The Johns Hopkins Univ. Press
6. Lee, W.F., Boehlje, M.D., Nelson, A.G., & Murray,W.G.(1998). Agricultural Finance, New Delhi: Kalyani Publishers. pp.1- 468
7. Reddy, S. S. and Ram, P.R. 1996. Agricultural Finance and Management. Oxford & IBH

Web-References:

1. www.rbi.org.in
2. www.nsic.co.in
3. www.nabard.org

Journals:

1. Agricultural Finance Review
2. Canadian Journal of Agricultural Economics
3. Journal of Agricultural Economics Research
4. American Journal of Environmental and Resource Economics

Course No.	:	AEG 301
Course Title	:	Renewable Energy in Agriculture and Allied Sector
Credit Hours	:	1+1
Course Category	:	Core Course

Course Learning Rationale/Course Objective (CLR):

1. To classify various sources of energy and understand their contribution to the agricultural sector.
2. To introduce biomass energy and its conversion into biofuels such as biodiesel and bioethanol
3. To familiarize students with different types of biogas plants, gasifiers, and their applications.

4. To provide knowledge on solar energy, its collection methods, and practical uses in agriculture through solar gadgets.
5. To introduce wind energy and explore the availability and application of biomass in different regions for agricultural use.

Course Learning Outcomes (CLO):

1. Identify and classify different sources of energy relevant to agriculture.
2. Demonstrate understanding of biomass conversion processes and biofuel production techniques.
3. Explain the structure and working of biogas plants, gasifiers, and other bioenergy systems.
4. Apply knowledge of solar energy and solar gadgets for agricultural and domestic purposes.
5. Understand the potential and practical applications of wind and biomass energy in various agro-climatic regions.

THEORY

Unit 1: Energy Sources and their role in Agriculture

Classification of energy sources, contribution of these of sources in agricultural sector;

Unit 2: Biomass and Biofuel Technologies

Familiarization with biomass utilization for biofuel production and their application;

Unit 3: Biogas, biodiesel and Gasification Systems

Familiarization with types of biogas plants and gasifiers, biogas, bio-alcohol, biodiesel and bio-oil production and their utilization as bioenergy resource;

Unit 4: Solar energy and its applications

Introduction of solar energy, collection and their application; Familiarization with solar energy gadgets: solar cooker, solar water heater, application of solar energy: solar drying, solar pond, solar distillation, solar photovoltaic system and their application;

Unit 5: Wind Energy Applications

Introduction of wind energy and their application. Availability of bio mass and their application in different places.

Theory - Lecture Schedule

1. Definition of energy and units of energy; Energy unit conversions – numerical problems; Derivation and understanding of physical quantities related to energy; Quality of fuels – Calorific value and its importance
2. Classification of energy – Conventional and Non – conventional energy; Energy crisis and its impact; Indian energy scenario: Contribution of energy sources to the

agricultural sector; Significance, potential, and achievements of energy use in India.

3. Biomass – definition and significance; Familiarization with biomass utilization for biofuel production and application.
4. Biodiesel – production process, stages and flowchart; Transesterification – chemistry of biodiesel production; Applications, advantages, and limitations of biodiesel.
5. Bioethanol – properties and uses; Manufacture of ethanol – preparation from molasses, starch and cellulosic material.
6. Biogas – composition and structure; Components and selection of site for biogas plant; Stages of biogas production – hydrolysis, acidogenesis, acetogenesis, and methanogenesis; Factors affecting biogas production – C:N ratio, hydraulic retention time.
7. Classification of biogas plants – batch and continuous type; Types of biogas plants – floating drum and fixed dome – KVIC and Dheenabandhu biogas plant; Applications of biogas.
8. Gasification – purpose and steps of gasification (thermochemical process); Feedstock treatment and composition of gasification products; Producer gas and syngas – differences; Types of gasifiers – updraft, downdraft, and fluidized bed gasifiers.

9. Mid Semester Examination

10. Introduction to solar energy - Familiarization with solar energy gadgets – Solar spectrum, extraterrestrial radiation, and solar constant; Solar radiation – types: global, direct, and diffuse radiation; Collection methods and applications of solar energy.
11. Solar dryer – types: direct and indirect; Advantages and limitations of solar dryers; Natural and forced convection type solar dryer
12. Solar pond – principle and working; Types of solar ponds. Solar distillation – construction and process; Solar still.
13. Solar cooker – energy required for cooking, specific heat, types of solar cookers; Solar water heater – construction and working process.
14. Solar photovoltaic system – solar cell, rated power; Problems on solar PV; Advantages and applications.
15. Introduction to wind energy – wind power, wind mills, and wind turbines. Types of wind mills – classification and working principles.
16. Efficiency of wind mills – factors affecting efficiency. Applications, advantages and limitations of wind energy systems.
17. Biomass resource assessment – availability of biomass in different regions; applications of biomass in various locations.

Practical

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

solar distillation, solar pond and solar wind hybrid system. Field visit to Solar –Wind farm

Practical Schedule

1. Study of basic principles of working of renewable energy gadgets.
2. Study of the production process of biodiesel – Chemistry of biodiesel.
3. Study of the production process of bio-ethanol – Preparation of bio-ethanol from molasses, starch, and cellulosic materials.
4. Study of stages of biogas production – Working principles of KVIC and Deenbandhu biogas plants.
5. Design of biogas plant – Gas holder and digester with numerical problems.
6. Study of briquetting process – Working mechanism and types of briquetting machines.
7. Study of gasifiers – Working process and different types of gasifiers.
8. Study of various solar energy gadgets.
9. Study of solar dryers – Direct and indirect types of solar dryers.
10. Study of solar cookers – Problem on energy requirement for cooking.
11. Study of solar pond – Principles, working process, and types.
12. Study of solar lighting, solar pumping, and solar fencing systems.
13. Study of solar distillation – Construction, working process, and design of solar still.
14. Study of solar photovoltaic systems – Problems on solar PV.
15. Study of solar fencing.
16. Study of wind energy – Working principle of windmills, their types, and efficiency.
17. **Final Practical Examination**

Suggested Readings:

1. C.S. Solanki. 2011. Solar Photovoltaic – Fundamentals, Technologies and Applications. PHI Learning Pvt. Ltd.
2. S. Sukhatme and J. Nayak. 2008. Solar Energy: Principles of Thermal Collection and Storage. Third Edition (Tata McGraw-Hill).

Course No.	:	AGM 301
Course Title	:	Agricultural Microbiology and Phyto-remediation
Credit Hours	:	1+1
Course Category	:	Core Course

Course Learning Rationale / Course Objective (CLR):

The purpose of learning this course is to:

1. Understand the basics of microbiology and its significance in agriculture.
2. Learn about bacterial structure and the function of its components.
3. Explore different areas of microbiology and their applications.
4. Study how microbes and plants help to clean polluted soils.
5. Learn the concept of biological control and the role of biopesticides in plant disease management.

Course Learning Outcome (CLO):

1. Basic understanding of microbiology and its importance in agriculture.
2. Understand the bacterial structure and functions of different bacterial components.
3. Identify key fields of microbiology and their applications in science and industry.
4. Understand the key players of microbes and plants in soil remediation and environmental cleanup.
5. Apply knowledge of biological control and biopesticides for effective plant disease management.

THEORY

Unit 1: Introduction and History of Microbiology

Introduction: Definition, applied areas of Microbiology and Importance of Microbiology. History of Microbiology - Discovery of microorganisms, spontaneous generation theory, Germ theory of diseases, Immunization, fermentation, and origin of life.

Unit 2: Microbial physiology and genetics

Bacterial morphology – arrangement of cells, structures and reproduction in bacteria; chemoautotrophy, photo autotrophy, Bacterial growth - Growth curve – Generation time and growth rate; Genetic recombination- transformation, conjugation and transduction, genetic engineering.

Unit 3: Environmental Microbiology

Soil Microbiology - Nutrient mineralization and transformation; Air Microbiology - Phyllosphere microflora, Phylloplane microflora, microflora of floral parts and endophytic microflora. Water microbiology - Types of water, water microorganisms, and microbial analysis of water e.g. coliform test, Purification of water.

Unit 4: Plant microbe interaction

Concepts of rhizosphere microbiology- Rhizodeposits -biochemical nature, release mechanism in rhizosphere, function, Carbon flow in rhizosphere, Rhizosphere microbiome residents and their roles. Potential of plant growth promoting rhizobacteria (PGPR) and endophytes on soil health and sustainability. Bioremediation of polluted soils using microbial mediators. Phytoremediation of polluted soils.

Unit 5: Industrial and food Microbiology

Microbial spoilage and principles of food preservations, Food poisoning. Microbial products, Biodegradation; Biofuel production – Biogas, Bioethanol, biohydrogen production and silage production; Biodegradable plastics. Biological control- Microbial insecticides and microbial agents for pest and plant disease management

Theory – Lecture Schedule

1. Definition, applied areas and Importance of Microbiology; Spontaneous generation theory, Germ theory of disease -Koch`s postulate
2. History and developments of microbiology - Contributions by Antonie Van Leeuwenhoek, Louis Pasteur, John Tyndall, Joseph Lister, Edward Jenner, Robert Koch, Alexander Fleming and Waksman.
3. Bacterial morphology – arrangement of cells, structures and reproduction in bacteria.
4. Bacterial growth - Growth curve – Generation time and growth rate.
5. Nutritional classification of bacteria- phototrophs, chemotrophs, autotrophs and heterotrophs.
6. Genetic recombination – Transformation, conjugation and transduction; Genetic engineering
7. Microbial transformation of nutrients in soil – carbon, nitrogen, phosphorous and sulphur
8. Rhizodeposits - Nature, mechanism, function and carbon flow in rhizosphere; Rhizosphere microbiome - residents and their roles- R:S ratio and their importance.

9. Mid Semester Examination

10. Microbial products, Biodegradation, Biofuel production – Biogas, Bioethanol and biohydrogen production; Biodegradable plastics and silage production.
11. Microbial insecticides and microbial agents for pest and plant disease management.
12. Microbial spoilage and principles of food preservations, Food poisoning.
13. Phyllosphere microbiology - microflora of Phyllosphere, Phylloplane, floral parts, and endophytes.
14. Plant growth promoting rhizobacteria (PGPR) and endophytes on soil health and sustainability.

15. Types of water, water microorganisms, and microbial analysis of water e.g. coliform test, Purification of water.
16. Bioremediation of polluted soils using microbial mediators.
17. Phytoremediation of polluted soils– Mechanism, processes, application and future prospects

Practical

Study of the microscope; Acquaintance with laboratory material and equipment; Microscopic observation of different groups of microorganisms: moulds (Fungi); Direct staining of bacteria by crystal violet; Negative or indirect staining of bacteria by nigrosine; Gram staining of bacteria; Study of phyllosphere and rhizosphere microflora; Measurement of microorganisms; Preparation of culture media; Isolation and purification of rhizospheric microbes; Isolation and purification of N-fixers; Isolation and purification of Nutrient solubilizers; Isolation and purification of Endophytes

Practical Schedule

1. Safety in Microbiology laboratory. Microscopes – handling light microscope
2. Micrometry-measurement of microorganisms
3. Sterilization – Principles and techniques –equipment and apparatus used for sterilization
4. Culture media preparation for bacteria, yeast, moulds and actinobacteria
5. Enumeration of soil microorganisms - serial dilution and plating technique (bacteria, fungi and actinobacteria)
6. Purification of bacteria and fungi
7. Staining – principles and techniques - simple staining: Direct and indirect staining
8. Differential staining - Gram and endospore staining
9. Morphological and biochemical characters of bacteria
10. Morphological characterization of yeast and Fungi
11. Isolation and purification of symbiotic N₂ fixing microorganism – *Rhizobium*
12. Isolation and purification of associative and non-symbiotic N₂ fixer: *Azospirillum* and *Azotobacter*
13. Isolation and purification of Phosphate solubilizing microorganisms
14. Isolation and purification of phyllo sphere and endophytic microorganisms
15. Isolation and purification of plant growth promoting rhizobacteria from rhizosphere soil
16. Isolation of pesticide degraders from soil
- 17. Final Practical Examination**

Suggested Readings:

1. Pelczar, M.J., Chan, E.C.S. and Kreig, N.R. 2002. Microbiology. 5th Edition, Tata McGraw-Hill, New Delhi.
2. Rangaswami, G. and Bagyaraj, D. J. 2005. Agricultural Microbiology. Prentice-Hall of India Pvt. Ltd., New Delhi.

3. Mukherjee, N. and Ghosh, T. 2004. Agricultural Microbiology. Kalyani Publishers, Calcutta
4. Dubey, H.C. 2007. A Textbook of Fungi, Bacteria and Viruses. Vikas Publishing House Ltd., New Delhi – 10014
5. Salyers, A. A. and Whitt, D. D. 2001. Microbiology: diversity, disease, and the environment. Fitzgerald Science Press, Inc.
6. Prescott, L. M. 2002. Microbiology 5th Edition. McGraw-Hill Inc, US

Course No.	:	AGR 303
Course Title	:	Rainfed Agriculture and Watershed Management
Credit Hours	:	1+1
Course Category	:	Core Course

Course Learning Rationale / Course Objectives (CLR):

1. To learn about characteristics and conditions of dryland/rainfed agriculture
2. To gain knowledge about drought and its mitigation
3. To impart knowledge on water harvesting and watershed management

Course Learning Outcome (CLO):

1. Understanding the basics of dryland/rainfed agriculture and its importance.
2. Learning management techniques of crops under dryland/rainfed areas
3. Knowing drought, its impact and mitigation strategies.
4. Understanding water harvesting and watershed management

THEORY

Unit 1: Dryland agriculture

Dryland/Rainfed agriculture: Introduction, types and characteristics; History of dry land/ rainfed agriculture in India; Problems and prospects of dry land/rainfed agriculture in India. Soil and climatic conditions prevalent in dry land/rainfed areas; Length of Growing Period (LGP) and Moisture Availability Index (MAI) and its impact on crop and cropping system; Soil and water conservation techniques.

Unit 2: Drought and Water Harvesting

Drought: types, effect of water deficit on physio-morphological characteristics of the plants; Crop adaptation and mitigation to drought. Water harvesting: importance, its techniques, Efficient utilization of water through soil and crop management practices;

Unit 3: Crop management in drylands

Crops and cropping systems in dry land/rainfed areas. Management of crops in dry land/rainfed areas; Contingent crop planning for aberrant weather conditions.

Unit 4: Watershed management

Concept, history, objective, principles and components of watershed management, factors affecting watershed management.

Unit 5: Forecasting and alternate land use

Long term rainfall analysis in relation to simple mathematical models and forecasting the weather abnormalities; Alternate land use system location; regional and crop specific dryland principles and practices for profitable and sustainable dryland farming and allied enterprises.

Lecture Schedule

1. Dryland/Rainfed agriculture: Introduction, types and characteristics.
2. History of dry land/ rainfed agriculture in India.
3. Problems and prospects of dry land/rainfed agriculture in India and Tamil Nadu.
4. Soil and climatic conditions prevalent in dry land/rainfed areas.
5. Length of Growing Period (LGP) and Soil Moisture Availability (SMA) and its impact on crop and cropping system.
6. Soil and water conservation techniques.
7. Drought: types, effect of water deficit on physio- morphological characteristics of the plants.
8. Crop adaptation and mitigation to drought.
- 9. Mid Semester Examination**
10. Water harvesting: importance, its techniques.
11. Efficient utilization of water through soil and crop management practices.
12. Crops and cropping systems in dry land/rainfed areas.
13. Management of crops in dry land/rainfed areas.
14. Contingent crop planning for aberrant weather conditions.
15. Concept, history, objective, principles and components of watershed management, factors affecting watershed management.
16. Long term rainfall analysis in relation to simple mathematical models and forecasting the weather abnormalities.
17. Alternate land use system location; regional and crop specific dryland principles and practices for profitable and sustainable dryland farming and allied enterprises.

Practical

Studies on climate classification, studies on rainfall pattern in rainfed areas of the country and pattern of onset and withdrawal of monsoons. Calculation of Length of Growing Period (LGP) and Soil Moisture Availability (SMA) 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 including mechanical and agronomic measure. Soil moisture determination under different land situations, Importance of seed priming to mitigate drought. Assessment of meteorological drought. Characterization and delineation of model watershed. Seed treatment, viz., seed hardening and seed priming techniques for all the agricultural crops Field demonstration on soil and moisture conservation measures. Field demonstration on construction of water harvesting structures. Visit to rainfed research station/watershed.

Practical Schedule

1. Studies on climate classification.
2. Studies on rainfall pattern in rainfed areas of the country and pattern of onset and withdrawal of monsoons.
3. Calculation of Length of Growing Period (LGP)
4. Calculation of Moisture Availability Index (MAI).
5. Studies on cropping pattern of different rainfed areas in the country and demarcation of rainfed area on map of India.
6. Interpretation of meteorological data and scheduling of supplemental irrigation on the basis of evapo-transpiration demand of crops.
7. Critical analysis of rainfall and possible drought period in the country.
8. Effective rainfall and its calculation.
9. Studies on cultural practices for mitigating moisture stress including mechanical and agronomic measure.
10. Soil moisture determination under different land situations
11. Acquiring skill on seed priming practices.
12. Characterization and delineation of model watershed.
13. Seed treatment, viz., seed hardening and seed priming techniques for all the agricultural crops
14. Field demonstration on soil and moisture conservation measures
15. Field demonstration on construction of water harvesting structures.
16. Visit to rainfed research station/watershed.
- 17. Final Practical Examination**

Suggested Readings:

1. A.K. Srivastava and P.K. Tyagi. 2011. Practical Agricultural Meteorology. New Delhi Publishing Agency, New Delhi.
2. D. Lenka. 2006. Climate, Weather and Crops in India. Kalyani Publishers, New Delhi.
3. G.S.L.H.V. Prasad Rao. 2008. Agricultural Meteorology. Prentice Hall of India Pvt. Ltd., New Delhi.

4. H.S. Mavi and Graeme J. Tupper. 2005. Agrometeorology – Principles and applications of climate studies in agriculture. International Book Publishing Co., Lucknow.
5. H.S. Mavi. 1994. Introduction to Agrometeorology. Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi.
6. H.V. Nanjappa and B.K. Ramachandrappa. 2007. Manual on Practical Agricultural Meteorology. Agrobios India. Jodhpur.
7. S.R. Reddy. 1999. Principles of Agronomy. Kalyani Publishers, New Delhi.
8. T. Yellamanda Reddy and G.H. Sankara Reddi. 2010. Principles of Agronomy. Kalyani Publishers, New Delhi.

Course No	:	BIC 301
Course Title	:	Essentials of Plant Biochemistry
Credit Hours	:	2+1
Course Category	:	Core Course

Course Learning Rationale / Course Objective (CLR):

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

Course Learning Outcomes (CLO):

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

THEORY

Unit 1: Carbohydrates and Lipids

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

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

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

Unit 2: Proteins and Enzymes

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

Enzymes - Properties, classification and nomenclature. Coenzymes, cofactors, vitamins and minerals as coenzymes / cofactors. Isoenzyme. Mechanism of enzyme action: Michaelis and Menten and Line Weaver Burk equation and plots. Factors affecting enzyme activity. Enzyme inhibition - Competitive, non-competitive and uncompetitive inhibitors. Introduction to allosteric enzymes. Use of enzymes.

Unit 3: Nucleic acids and Vitamins

Nucleic acids: Function, classification, properties, structure. Replication, transcription and translation.

Vitamins: Physiological and metabolic role.

Unit 4: Metabolism – Catabolism

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

Unit 5: Biosynthetic Pathways and Secondary metabolites

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

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

Theory - Lecture schedule:

1. Biochemistry – Introduction and importance, Properties of water, pH and buffer, plant cell and its components.
2. Carbohydrates – occurrence, importance and classification. Structure of mono saccharides
3. Structure of, oligosaccharides and polysaccharides.
4. Physical and chemical properties of carbohydrates – optical isomerism, optical activity, mutarotation, reducing property, reaction with acids and alkalis.
5. Lipids – occurrence and classification. Storage lipids - Fatty acids and triacyl glycerol. Essential fatty acids.
6. Structural lipids - Glycolipids and phospholipids - types and importance. Physical and chemical constants of oils. Rancidity of oils.

7. Sterols - basic structure and their importance.
8. Amino acids - Classification and structure. Essential amino acids.
9. Properties of amino acids – colour reactions, amphoteric nature and isomerism.
10. Importance and classification of proteins based on function and solubility.
11. Structure of protein - Primary, secondary, tertiary and quaternary structure.
12. Protein folding and denaturation. Physical and chemical properties of proteins.
13. Enzymes - Properties, classification and nomenclature. Coenzymes, cofactors, vitamins and minerals as coenzymes / cofactors. Isoenzyme.
14. Mechanism of enzyme action; Michaelis & Menten and Line Weaver Burk equation and plots.
15. Factors affecting enzyme activity. Enzyme inhibition - competitive, non-competitive, uncompetitive inhibitors. Introduction to allosteric enzymes. Use of enzymes.
16. Nucleic acids: Function, classification, properties, structure.

17. Mid Semester Examination

18. RNA: Types and Secondary & Tertiary structure
19. Replication, transcription and translation.
20. Vitamins: Physiological and metabolic role.
21. Metabolism – Basic concepts - Carbohydrate metabolism - breakdown of starch by amylases.
22. Glycolysis and TCA cycle - Reactions and bioenergetics.
23. Pentose phosphate pathway – Reactions.
24. Respiration - electron transport chain and oxidative phosphorylation.
25. Lipid metabolism - lipases and phospholipases.
26. Beta-oxidation of fatty acids and bioenergetics.
27. Photosynthesis, Gluconeogenesis, nitrogen fixation
28. Fatty acid and starch formation.
29. Nitrogen fixation - Ammonia assimilating enzymes - GS, GOGAT and GDH.
30. Biosynthesis of fatty acids and triacylglycerol.
31. Regulation of metabolic pathways.
32. Secondary metabolites - occurrence, classification and functions of phenolics, terpenoids and alkaloids. Applications of secondary metabolites in food and pharmaceutical industries.

Practical

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

Practical Schedule

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

17. Final Practical Examination

Suggested Readings:

1. Rastogi S.D., 2010, Biochemistry, 3rd edn, Tata McGraw-Hill, Delhi
2. Murray,R.K., Granner,D.K., Mayes,P.A.. and Rodwell,V.W., 2003.26th edn, Tata McGraw-Hill, New Delhi
3. Nelson DL, Cox MM. 2004. Lehninger Principles of Biochemistry Fourth (Indian edition) MacMillian, Worth Publishers.
4. Voet D,Voet JG and CW Pratt. 2002. Biochemistry. John Wiley & Sons, Inc, Singapore
5. Thayumanavan, B, Krishnaveni, S and Parvathi, K. 2004. Biochemistry for Agricultural Science, Galgotia Publications Pvt Ltd., New Delhi
6. Sadasivam S and Manickam, A. Biochemical Methods, 2009, 3rd edn., New Age International
7. Wilson, K. and Walker, J.M. 2000. Principles and techniques of Practical Biochemistry, 5th edn. – Cambridge University Press.
8. Conn, E.E. and Stumpf, P.K.1996. Outlines of Biochemistry – Wiley Eastern Ltd., Fifth Edition.
9. Stryer L, Berg T,Tymoczko,J, Biochemistry.,2009 5th Ed. Wiley Eastern Ltd, New Delhi
10. Chesworth, J.M., Stuchbury, T. and Scaife, J.R. 1998. An Introduction to Agricultural Biochemistry. Chapman and Hall.
11. Goodwin, T.W. and Mercer, E.I. 1991. Introduction to Plant Biochemistry. Pergamon Press.

Course No.	:	GPB 302
Course Title	:	Crop Improvement (<i>Rabi</i> crops) – II
Credit Hours	:	1+1
Course Category	:	Core Course

Course Learning Rationale / Course Objective (CLR):

1. Exploring the historical origin, domestication, and genetic base of Rabi crops.
2. Understanding conventional and modern breeding approaches aimed at enhancing productivity, resilience, and quality.
3. Addressing challenges in breeding for tolerance to biotic and abiotic stresses.
4. Developing analytical skills to interpret crop performance and varietal suitability.
5. Introducing advanced molecular and biotechnological tools for crop enhancement.

Course Learning Outcome (CLO):

1. Trace the genetic background and origin of major Rabi crops and identify sources of genetic variability.
2. Demonstrate understanding of key breeding strategies employed for improving traits like yield, nutritional quality, and stress resistance.
3. Apply knowledge of inheritance patterns to plan and implement suitable breeding methods.
4. Critically evaluate improved genotypes and released varieties for performance under varying environmental conditions.
5. Integrate traditional and modern breeding tools, including molecular markers and genomics, in crop improvement programs.

THEORY

Unit 1: Wheat, Oat and Chick pea

Centres of origin, distribution of species, wild relatives in Wheat, Oat and Chick pea; Plant genetic resources, its utilization and conservation, study of genetics of qualitative and quantitative characters; Important concepts of breeding self-pollinated, cross-pollinated and vegetatively propagated crops. Major breeding objectives and procedures including conventional and modern innovative approaches for development of hybrids and varieties for yield, adaptability, stability, abiotic and biotic stress tolerance and quality (physical, chemical, nutritional); Ideotype concept, climate resilient crop varieties for future. Hybrid seed production technology.

Unit 2: Rapeseed and Mustard, Sunflower and Safflower

Centres of origin, distribution of species, wild relatives in Rapeseed and Mustard, Sunflower and Safflower; Plant genetic resources, its utilization and conservation, study of genetics of qualitative and quantitative characters; Important concepts of breeding self-

pollinated, cross-pollinated and vegetatively propagated crops. Major breeding objectives and procedures including conventional and modern innovative approaches for development of hybrids and varieties for yield, adaptability, stability, abiotic and biotic stress tolerance and quality (physical, chemical, nutritional); Ideotype concept, climate resilient crop varieties for future. Hybrid seed production technology

Unit 3: Sugarcane and Potato

Centres of origin, distribution of species, wild relatives in Sugarcane and Potato; Plant genetic resources, its utilization and conservation, study of genetics of qualitative and quantitative characters; Important concepts of breeding self-pollinated, cross-pollinated and vegetatively propagated crops. Major breeding objectives and procedures including conventional and modern innovative approaches for development of hybrids and varieties for yield, adaptability, stability, abiotic and biotic stress tolerance and quality (physical, chemical, nutritional); Ideotype concept, climate resilient crop varieties for future. Hybrid seed production technology.

Unit 4: Tomato and chilli

Centres of origin, distribution of species, wild relatives in Tomato and chilli; Plant genetic resources, its utilization and conservation, study of genetics of qualitative and quantitative characters; Important concepts of breeding self-pollinated, cross-pollinated and vegetatively propagated crops. Major breeding objectives and procedures including conventional and modern innovative approaches for development of hybrids and varieties for yield, adaptability, stability, abiotic and biotic stress tolerance and quality (physical, chemical, nutritional); Ideotype concept, climate resilient crop varieties for future. Hybrid seed production technology.

Unit 5: Onion and Garlic

Centres of origin, distribution of species, wild relatives in Onion and Garlic; Plant genetic resources, its utilization and conservation, study of genetics of qualitative and quantitative characters; Important concepts of breeding self-pollinated, cross-pollinated and vegetatively propagated crops. Major breeding objectives and procedures including conventional and modern innovative approaches for development of hybrids and varieties for yield, adaptability, stability, abiotic and biotic stress tolerance and quality (physical, chemical, nutritional); Ideotype concept, climate resilient crop varieties for future. Hybrid seed production technology.

Theory - Lecture Schedule

- 1-3. Crop Improvement in Wheat
- 4-5. Crop improvement in Oat
6. Crop improvement in Chick pea
- 7-8. Crop Improvement in Rapeseed and Mustard
- 9. Mid semester Examination**
10. Crop improvement in Sunflower
11. Crop improvement in Safflower
12. Crop improvement in Sugarcane
13. Crop improvement in Potato

14. Crop improvement in Tomato
15. Crop improvement in Chili
16. Crop improvement in Onion
17. Crop improvement in Garlic

Practical

Botany of crops, Floral biology, emasculation and hybridization techniques in different crop species, viz. Wheat, Oat, Chick pea, Rapeseed and mustard, Sunflower, Safflower, Sugarcane, Potato, Tomato, Chilli, Onion and Garlic. Maintenance breeding of different *rabi* crops. Handling of germplasm and segregating populations by different methods like pedigree, bulk and single seed decent methods; Study of field techniques for seed production and hybrid seed production in kharif crops; Estimation of heterosis, inbreeding depression and heritability; Layout of field experiments; Study of quality characters, donor parents for different characters; Visit to seed production plots; Visit to AICRP breeding plots of different crops.

Practical Schedule

1. Botany of crops, Floral biology, emasculation and hybridization techniques in Wheat
2. Botany of crops, Floral biology, emasculation and hybridization techniques in Oat
3. Botany of crops, Floral biology, emasculation and hybridization techniques in Chick pea
4. Botany of crops, Floral biology, emasculation and hybridization techniques in Rapeseed and Mustard
5. Botany of crops, Floral biology, emasculation and hybridization techniques in Sunflower
6. Botany of crops, Floral biology, emasculation and hybridization techniques in Safflower
7. Botany of crops, Floral biology, emasculation and hybridization techniques in Sugarcane
8. Botany of crops, Floral biology, emasculation and hybridization techniques in cotton
9. Botany of crops, Floral biology, emasculation and hybridization techniques in Jute
10. Botany of crops, Floral biology, emasculation and hybridization techniques in Potato
11. Botany of crops, Floral biology, emasculation and hybridization techniques in Tomato
12. Botany of crops, Floral biology, emasculation and hybridization techniques in Chili
13. Botany of crops, Floral biology, emasculation and hybridization techniques in Onion
14. Botany of crops, Floral biology, emasculation and hybridization techniques in Garlic
15. Visit to Seed production plots
16. Visit to AICRP breeding plots of different Rabi crops
- 17. Final Practical Examination**

Suggested Readings:

1. Breeding field crops -I by V.L. Chopra
2. Genetic improvement of field crops by C.B. Singh and D. Khare
3. Genetics and Breeding of Pulse crops by D.P. Singh
4. Vegetable breeding – Principles and Practices by Hari Har Ram
5. Breeding field crops by D.A. Sleper and J.M. Poehlman
6. Plant Breeding –theory and practice by S.K. Gupta 92 2(1+1)
7. Breeding Asian field crops by J.M. Poehlman and D.N. Barthakur
8. Practical manuals on Crop Improvement I (Kharif crops) by Rajendra Kumar Yadav.

Course No	:	GPB 303
Course Title	:	Fundamentals of Agricultural Biotechnology
Credit Hours	:	2+1
Course Category	:	Core Course

Course Learning Rationale / Course Objective (CLR):

The purpose of learning this course is to:

1. Understand Basic Concepts: To provide foundational knowledge of biotechnology principles and their relevance to agriculture, including genetic engineering, molecular biology, and tissue culture techniques.
2. Explore Applications in Agriculture: To familiarize students with various biotechnological tools and their applications in crop improvement, pest and disease resistance, and sustainable agriculture.
3. Develop Problem-Solving Skills: To enable students to analyze and apply biotechnological solutions for real-world agricultural challenges such as drought, salinity, and nutrient deficiencies.
4. Introduce Regulatory and Ethical Aspects: To create awareness about the ethical, legal, and social implications of biotechnology in agriculture, including biosafety and intellectual property rights.
5. Promote Research Orientation: To encourage critical thinking and foster interest in advanced research through exposure to case studies, recent developments, and innovations in agricultural biotechnology.

Course Learning Outcomes (CLO):

1. *Explain* the basic principles and concepts of agricultural biotechnology, including genetic engineering, molecular markers, and tissue culture techniques.

2. *Apply* biotechnological tools and techniques for crop improvement, including trait selection, gene transfer, and development of genetically modified organisms (GMOs).
3. *Analyze* the role of biotechnology in addressing agricultural problems such as biotic and abiotic stress, pest resistance, and low productivity.
4. *Evaluate* the ethical, environmental, and regulatory aspects related to the use of biotechnology in agriculture, including biosafety guidelines and IPR issues.
5. *Demonstrate* an ability to design simple experimental approaches and interpret data related to plant biotechnology and genetic transformation.

THEORY

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

Theory - 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

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.

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**

Suggested Readings:

1. Chawla. H S. 2009. Introduction to Plant Biotechnology (3/e). CRC Press, London. 730 P ISBN 9781578086368

2. Boopathi, N. M. 2013. Genetic Mapping and Marker Assisted Selection - Basics, Practice and Benefits. Springer Publications
3. Brown, T. A. 2010. Gene Cloning and DNA Analysis: An Introduction, 6th Edition, Wiley Blackwell- Companion site (Chapters 1 to 12 and 15)
4. Chahal, G. S. and Gosal, S. S. 2003. Principles and Procedures of Plant Approaches Breeding Biotechnological and Conventional. Narosa Publishing House, New Delhi
5. Dubey, R. C. 2014. A textbook of Biotechnology. 5th revised Edn. S. Chand Publications. New Delhi
6. Gupta, P. K, 2015. Elements of Biotechnology 2nd Edn. Rastogi and Co. , Meerut. Neal Stewart, Jr. C. 2008. Plant Biotechnology and Genetics: Principles, Techniques and Applications John Wiley & Sons, Inc ISBN: 978-0-470-04381-3
7. Nelson, D. S. and M. M. Cox. 2012. Lehninger's Principles of Biochemistry. Sixth edition. Chapters- 1,3,8,9,25,26,28 (weblinks, tutorials and lecture companion art)
8. W.H. Freeman and Singh, B. D. 2012. Plant Biotechnology. Kalyani publishers, Ludhiana.
9. Xu, Y. 2010. Molecular Plant Breeding. International Maize and Wheat Improvement Centre (CIMMYT). 752 Page

Web- References:

1. <http://www.agbiotechnet.com>
2. <http://www.agbioworld.org>
3. <http://www.agbiosafety.unl.edu/>

Course No.	:	SST 301
Course Title	:	Fundamentals of Seed Science and Technology
Credit hours	:	1+1
Course category	:	Core Course

Course Learning Rationale / Course Objective (CLR):

1. To understand the basics and importance of seed science and technology.
2. To learn how to produce quality seeds of major crops.
3. To know the methods of seed processing, treatment and storage.
4. To become familiar with seed laws, certification and quality standards.
5. To gain practical skills in seed testing and field inspection.

Course Learning Outcomes (CLO):

1. Understand the key concepts and importance of seed quality.
2. Identify different classes of seeds and their production techniques.
3. Apply proper methods for seed processing, treatment and storage.

4. Demonstrate knowledge of seed certification and legal regulations.
5. Perform basic seed testing methods and field inspections effectively.

THEORY

Unit 1: Seeds and their importance

Introduction to seed technology: definition - importance – Seed quality - definition, characteristics of good quality seed – Causes of deterioration of varietal purity and assessment of genetic purity - Different classes of seed.

Unit 2: Seed Production

Foundation and certified seed production of important Cereals - rice, maize, sorghum and bajra - Pulses – green gram, black gram and red gram - Oilseeds - groundnut, sesame, sunflower and castor – field inspection, importance and procedure.

Unit 3: Post harvest handling of seeds

Post - harvest seed quality management - Seed processing procedures – equipments - seed drying - Seed quality enhancement techniques.

Unit 4: Seed Quality Control and Seed Testing

Seed certification and legislation - Seed Act - Seed Act enforcement - Duty and powers of seed inspector, offences and penalties. Seeds Control Order 1983 - basics of seed quality testing – New Seed Bill 2019.

Unit 5: Seed Storage

Seed treatments, its importance, methods of application and seed packaging. Seed storage – general principles - stages and factors affecting seed longevity during storage – Seed health management during storage.

Theory - Lecture Schedule:

1. Introduction to seed technology - definition - importance – seed quality - definition - Characteristics of good quality seed.
2. Causes of deterioration of varietal purity and assessment of genetic purity - Different classes of seed.
3. Foundation and certified seed production of rice.
4. Foundation and certified seed production of maize.
5. Foundation and certified seed production of sorghum and bajra.
6. Foundation and certified seed production of pulses (Black gram, green gram and red gram).
7. Foundation and certified seed production of oilseeds (groundnut and sesame).
8. Foundation and certified seed production of oilseeds (sunflower and castor).
- 9. Mid Semester Examination**
10. Post harvest seed quality management - Seed processing procedures – equipments – seed drying.

11. Seed quality enhancement techniques.
12. Basics of seed quality testing.
13. Seed certification - Field inspection – importance and procedures.
14. Seed legislation - Seed Act and Rules - Seed law enforcement - Duties and powers of seed inspector - offences and penalties – Seeds Control Order 1983 – New Seed Bill, 2019.
15. Seed treatment, its importance - method of application and Seed packaging
16. Seed storage - principles - factors affecting seed longevity during storage
17. Seed health management during storage.

Practical

Seed Structure, Seed sampling, Physical purity, Moisture determination, Germination test, Seed and seedling vigour test, Seed Viability, Genetic purity test: Grow out test, Field inspection, Seed health testing using blotter and agar plate method. Visit to seed production farms, seed testing laboratories and seed processing plant.

Practical Schedule:

1. Study on external and internal seed structure and identification of agricultural crops.
2. Study on external and internal seed structure and identification of horticultural crops.
3. Seed sampling – Mixing and dividing of seeds.
4. Physical purity analysis.
5. Estimation of seed moisture content.
6. Seed germination testing.
7. Seed germination test – Seedling evaluation.
8. Seed viability testing - tetrazolium test - evaluation.
9. Seed and seedling vigour test.
10. Genetic purity test - grow out test.
11. Seed certification - field inspection and counting procedure - identification of physical and genetic contaminants in seed production plots and roguing.
12. Seed health test using blotter and agar plate method.
13. Visit to seed production farms.
14. Visit to seed testing laboratory.
15. Visit to seed processing plant.
16. Seed production planning - economics.
- 17. Final Practical Examination**

Suggested Readings:

1. Agarwal, R.L. 1995. Seed Technology (2nd edition). Oxford & IBH Publishing Co. Pvt. Ltd. New Delhi, India.
2. Khare, D. and Bhale, M.S. 2019. Seed Technology (2nd revised & enlarged edn), Scientific Publishers, ISBN: 978-81-72338-84-8, New Pali Road, P.O. Box 91, Jodhpur, India

3. Vanangamudi, K. 2014. Seed Technology (An illustrated book), New India Publishing Agency, New Delhi, India.
4. Bhojwani, S.S. and Bhatnagar, S.P. 1999. The Embryology of Angiosperm. Vikas Publication.
5. McDonald, M.B. Jr and Copeland, L.O. 1997. Seed Production: Principles and Practices. Chapman & Hall.
6. Tunwar, N.S. and Singh, S.N. 1988. Indian Minimum Seed Certification Standards. CSCB, Ministry of Agriculture, New Delhi.

Web-References:

1. www.fao.org
2. www.seednet.gov.in
3. www.agricoop.nic.in
4. www.online library.wiley.com
5. www.sciencedirect.com

Course No	:	STA 301
Course Title	:	Basic and Applied Agricultural Statistics
Credit Hours	:	2+1
Course Category	:	Core Course

Course Learning Rationale / Course Objective (CLR):

The purpose of learning this course is to:

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

Course Learning Outcomes (CLO):

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

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

THEORY

Unit 1: Data summarisation and descriptive statistics

Diagrammatic representation of data, Graphical representation of data; Histogram, frequency polygon, frequency curve, ogives. Introduction, Measures of central tendency, arithmetic mean, geometric mean, harmonic mean, median and mode –Merits and demerits. Measures of dispersion: Range, Quartile deviation, Mean deviation, standard deviation, and coefficient of variation, Skewness and kurtosis, Merits and demerits.

Unit 2: Probability distributions

Probability theory- Basic terminologies. Classical probability, Empirical probability and Axiomatic Probability, Additional theorem and multiplication theorem, Conditional probability - Bayes theorem. Probability distributions, Discrete distributions: Bernoulli, Binomial and Poisson. Continuous distribution: Normal distribution, definitions and properties.

Unit 3: Correlation and Regression

Correlation, Scatter diagram, Karl Pearson's correlation coefficient, Spearman's rank correlation, computation and properties. Regression, simple linear regression, fitting of simple linear regression equation, properties of regression coefficient. Null and alternative hypothesis, types of errors, critical region and tests of significance.

Unit 4: Inferential statistics

Large sample test, single mean and difference between two means, single proportion and difference between two proportions. Small sample tests, F-test, t-test for testing the significance of single mean – independent and paired t test, chi square test for testing the association of $r \times c$ contingency table. Analysis of Variance (ANOVA), assumptions, one way and two-way classifications.

Unit 5: Experimental Designs and Sampling Theory

Basic principles of experimental designs, Completely Randomized Design (CRD), Randomized Block Design (RBD), and Latin Square Design (LSD). Sampling theory, population, sample, parameter and statistic, sampling distribution, sampling vs complete enumeration, Types of sampling, simple random sampling, selection using random numbers, Stratified, Systematic sampling.

Theory - Lecture Schedule

1. Introduction to statistics and its applications in Agriculture. Data- Types, scale of measurement.
2. Frequency distribution, method of classification. Definition of grouped and ungrouped data.
3. Diagrammatic representation & Graphical representation
4. Measures of central tendency: arithmetic mean, geometric mean, harmonic mean—Merits and demerits
5. Measures of central tendency: Median and mode –Merits and demerits

6. Measures of dispersion: Range, Quartile deviation, Mean deviation, standard deviation, and coefficient of variation, Merits and demerits
7. Skewness and Kurtosis
8. Probability theory- Basic terminologies. Classical probability
9. Empirical probability and Axiomatic Probability
10. Additional theorem and multiplication theorem
11. Conditional probability - Bayes theorem
12. Discrete probability distribution – Binomial & Poisson
13. Continuous probability distribution – Normal
14. Correlation – Scatter diagram - Karl Pearson's correlation coefficient
15. Spearman's rank Correlation - computation and properties
16. Regression – simple linear regression
17. **Mid Semester Examination**
18. Fitting of simple linear regression equation – properties of regression coefficient
19. Null and alternative hypothesis – types of errors - critical region and tests of significance
20. Large sample test – single mean and difference between two means.
21. Large sample test – single proportion and difference between two proportions
22. Small sample tests – F-test, t-test for testing the significance of single mean
23. Small sample tests – Independent t test for difference between two sample means (equal variances only), Paired t-test
24. Chi square test for testing the association of $r \times c$ contingency table.
25. Analysis of Variance (ANOVA) – assumptions – one way and two-way classifications.
26. Basic principles of experimental designs
27. Analysis of Completely Randomized Design (CRD) – for equal replications only
28. Analysis of Randomized Block Design (RBD)
29. Latin Square Design (LSD)
30. Sampling theory – population – sample – parameter and statistic – sampling distribution
31. Sampling vs complete enumeration –Types of sampling - simple random sampling selection using random numbers,
32. Stratified, Systematic sampling.

Practical

Diagrammatic representation & Graphical representation. Measures of central tendency. Measures of dispersion. Simple problems in Binomial distribution, Poisson distribution and Normal distribution. Computation of Karl Pearson's correlation coefficient. Fitting of simple linear regression equation y on x – correlation and regression. Large sample test – test for single proportion and difference between two proportions. Large sample test – test for single mean and difference between two means. Small samples test – t-test for single mean – t test for difference between two sample

means (equal variances only), Paired t-test. Chi square test. Analysis of Completely Randomized Design (CRD) – for equal replications only. Analysis of Randomized Block Design (RBD). Selection of sample using simple random sampling method.

Practical Schedule

1. Diagrammatic representation & Graphical representation
2. Measures of central tendency: arithmetic mean, geometric mean, harmonic mean
3. Measures of central tendency: Median and mode
4. Measures of dispersion
5. Simple problems in Binomial distribution
6. Simple problems in Poisson distribution
7. Simple problems in Normal distribution
8. Computation of Karl Pearson 's correlation coefficient
9. Fitting of simple linear regression equation y on x
10. Large sample test – test for single proportion and difference between two proportions
11. Large sample test – test for single mean and difference between two means
12. Small samples test – t-test for single mean – t test for difference between two sample means (equal variances only), Paired t-test
13. Chi square test
14. Analysis of Completely Randomized Design (CRD) – for equal replications only
15. Analysis of Randomized Block Design (RBD)
16. Selection of sample using simple random sampling method
- 17. Practical Examination**

Suggested Readings:

1. Rangaswamy, R. (1995). A Text Book of Agricultural Statistics. Hyderabad: New Age International Publishing Limited. pp. 1- 526
2. Gupta, S. C. & Kapoor, V. K. (2014). Fundamentals of Mathematical Statistics. New Delhi: Sultan chand and sons. pp. 1-682
3. Fundamentals of Applied Statistics by S.C. Gupta and V. K. Kapoor, Sultan Chand and Sons.
4. Basic Statistics by B. L. Agarwal, New Age International Publishers.
5. Agricultural Statistics by S.P. Singh and R.P.S. Verma, Rama Publishing House.
6. Agriculture and Applied Statistics-I by P.K. Sahu, Kalyani Publishers.
7. Agriculture and Applied Statistics-II by P. K. Sahu and A. K. Das, Kalyani Publishers.
8. Panse, V.G. & Sukhatme, P. V. (1954). *Statistical Methods for Agricultural Workers*. India: Indian Council of Agricultural Research. pp. 1- 361

FOURTH YEAR**VII SEMESTER**

Sl.No.	Course No.	Course Title	Cr.Hr.
1.	-	5 Elective courses each of 3+1 credit	15 + 5
		TOTAL	15+5=20

List of Elective courses

Sl.No.	Course No.	Course Title	Cr.Hr.	Semester
1	AEC 401	Agri-Business Management	3+1	VII
2	AEN 401	Sericulture	3+1	VII
3	AEX 401	Agricultural Journalism	3+1	VII
4	AGM 401	Bio-pesticides and Bio-fertilizers	3+1	VII
5	AGM 402	Applied Microbiology	3+1	VII
6	AGR 401	System Simulation and Agro-advisory	3+1	VII
7	AGR 402	Climate Resilient Agriculture	3+1	VII
8	AGR 403	Geo-informatics and Remote Sensing, Precision Farming	3+1	VII
9	AGR 404	Principles and Practices of Organic Farming/ Conservation Agriculture	3+1	VII
10	GPB 401	Commercial Plant Breeding	3+1	VII
11	GPB 402	Biotechnology of Crop Improvement	3+1	VII
12	GPB 403	Micro-propagation Technologies	3+1	VII
13	HOR 401	Hi-tech Horticulture	3+1	VII
14	PAT 401	Plant Diseases Detection, Diagnosis and Management	3+1	VII
15	PHT 401	Post-Harvest Technology and Value Addition	3+1	VII
16	SAC 401	Management of Natural Resources	3+1	VII
17	SAC 402	Agrochemicals	3+1	VII
18	SST 401	Commercial Seed Production	3+1	VII

Course No.	:	AEC 401
Course Title	:	Agri-Business Management
Credit Hours	:	3+1
Course Category	:	Elective Course

Course Learning Rationale / Course Objective (CLR):

The purpose of learning this course is to:

1. Expose the students to functional areas of agribusiness management and its applications
2. Understand the concept of entrepreneurship, entrepreneurial competencies
3. Expose on the entrepreneurial opportunities
4. Expose the students to various management issues in establishing a business and to inculcate success.
5. Understand the Networking techniques explore various types of business strategies and entrepreneurship concepts that should help define the learning methods and goals.

Course Learning Outcomes (CLO):

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

1. To understand the key concepts, components, and evolution of agribusiness
2. Understand the concept of entrepreneurship, entrepreneurial competencies
3. Expose on the entrepreneurial opportunities
4. Expose the students on various management issues in establishing a business and to inculcate success.
5. Explore various business strategies and entrepreneurship concepts that should help define the learning methods and goals.

THEORY

Unit 1: Introduction to Agribusiness

Agribusiness – Definition – Evolution of Agribusiness - Agribusiness status in developed and developing nations. Special features of Agribusiness – Scope for Agribusiness in India. Government Promotional Programmes in Agribusiness. Classification of Enterprises- Micro, Small, Medium, and Large. Forms of Business Organisation – Sole Proprietorship – Partnership –Private and Public Limited. Transformation of agriculture into agribusiness, various stakeholders, and components of agribusiness systems. Importance of agribusiness in the Indian economy and New Agricultural Policy.

Unit 2: Importance of Agribusiness Management

Distinctive features of Agribusiness Management: Importance and needs of agro-based industries, Classification of industries and types of agro-based industries. Institutional arrangement, and procedures to set up agro-based industries. Constraints in

establishing agro-based industries. Agri-value chain: Understanding primary and support activities and their linkages.

Unit 3: Business Environment

Business environment: PERT and SWOT analysis. Management functions: Roles and activities, Organization culture. Planning, meaning, definition, types of plans. Purpose or mission, goals or objectives, Strategies, policies procedures, rules, programs, and budget. Components of a business plan, Steps in planning and implementation. Organization staffing, directing, and motivation.

Unit 4: Financial and Marketing Management

Ordering, leading, supervision, communications, control. Capital Management and Financial Management of Agribusiness. Financial statements and their importance. Marketing Management: segmentation, targeting, and positioning. Marketing mix and marketing strategies. Consumer behavior analysis, Product Life Cycle (PLC). Sales and Distribution Management. Pricing policy and various pricing methods.

Unit 5: Project Management

Project management – project cycle – identification, formulation, appraisal, implementation, monitoring, and evaluation. Project appraisal – evaluation techniques

Theory - Lecture Schedule

1. Agribusiness – Definition – Evolution of Agribusiness
2. Agribusiness status in developed and developing nations
3. Special features of Agribusiness – Scope for Agribusiness
4. classification of Enterprises - Micro, Small, Medium, and Large in India
5. characteristics of Enterprises - Micro, Small, Medium, and Large in India
6. Forms of Business Organisation – Sole Proprietorship – Partnership –Private and Public Limited.
7. Transformation of agriculture into agribusiness, various stakeholders
8. Components of agribusiness systems.
9. Importance of agribusiness in the Indian economy
10. New Agricultural Policy
11. Distinctive features of Agribusiness Management
12. Importance and needs of agro-based industries
13. Classification of industries and types of agro-based industries.
14. Institutional arrangement, and procedures to set up agro-based industries.
15. Constraints in establishing agro-based industries.
16. Agri-value chain
17. Understanding primary and support activities and their linkages.
18. Role of technology and innovation in value chain development
19. Challenges in building and sustaining the value chain in agribusiness
20. Business environment

21. Management functions: Roles & activities, Organization culture.
22. Business Environment: Internal and external factors affecting agribusiness.
23. PERT Analysis; SWOT Analysis: Identifying strengths, weaknesses, opportunities, and threats.
24. Management Functions Overview: Planning, organizing, staffing, directing, and controlling.
25. **Mid Semester Examination**
26. Planning in Agribusiness: Meaning, importance, and types of plans.
27. Components of Planning: Mission, goals, objectives, policies, procedures, and budgets.
28. Organizing and Staffing: Resource allocation and team building in agribusiness
29. Introduction to Financial Management: Role in agribusiness.
30. Capital Management: Sources of funding and resource allocation.
31. Financial Statements: Balance sheets, profit & loss, and cash flow statements.
32. Discounting; Undiscounting measures
33. Budgeting in Agribusiness: Preparation, monitoring, and control.
34. Introduction to Marketing Management: Importance and key concepts.
35. Market Segmentation, Targeting, and Positioning (STP): Techniques for identifying customers.
36. Marketing Mix: Product, price, place, promotion, and people strategies.
37. Consumer Behaviour: Analyzing buying patterns and decision-making in agribusiness.
38. Marketing strategies for an agro-product.
39. Introduction to Project Management: Definition, scope, and importance.
40. Project Life Cycle: Identification, formulation, appraisal, implementation, and monitoring.
41. Project Appraisal Techniques: Financial, technical, and environmental assessments.
42. Monitoring and Evaluation: Tools and performance indicators for projects.
43. Project proposal for an agribusiness.
44. Sales and Distribution Management: Managing supply chains and logistics.
45. Pricing Policies: Various methods and their applications in agribusiness.
46. Evaluating a successful agribusiness project
47. Future of Agribusiness; Emerging trends in Agribusiness
48. Opportunities, and innovations in Agribusiness

Practical

Study of Agri –input markets: Seed, fertilizers pesticides. Study of output markets: grains, fruits, vegetables, flowers. Study of product market, retail trade commodity trading, and value-added products. Study of financing institutions- Cooperative, Commercial Bank, RRBs, Agribusiness Finance Limited, NABARD. Preparations of projects and Feasibility reports for agribusiness entrepreneurs. Appraisal /evaluation techniques of identifying viable project- Non-discounting techniques. Case study of agro-

based industries. Trend and growth rate of the price of agricultural commodities. Net present worth technique for selection of viable project. Internal rate of return.

Practical Schedule

1. Identification of new agri-business opportunities.
2. Study of Agri-input markets: Seeds, fertilizers, pesticides
3. Study of output markets Agricultural commodity like grains & Pulses
4. Study of output Market perishable commodities fruits, vegetables, flowers.
5. Study of product market, retail trade commodity trading, and value-added products.
6. Starting a new business – visit to firms/discussion with entrepreneurs
7. Documenting procedure for establishing Agribusiness firms
8. Government programs and institutions for entrepreneurship development
9. Visit to financial institutions
10. Study of agribusiness finance limited
11. Preparation of projects and feasibility reports for agribusiness entrepreneurs.
12. Appraisal evaluation techniques for identifying viable projects
13. Discounting and non-discounting techniques
14. Case study of agro-based industries
15. NPV & BCR
16. IRR techniques for selection of viable project
17. **Final Practical Examination.**

Suggested Readings:

1. A Textbook of Agri-business Management- Sanket S. Kadam, Universal Prakashan,
2. Agri-business: Management, Marketing, Human Resource Development, Communication, and Technology by Robert H. Usry and Lanny W. Hass
3. Broadway, A.C. and Broadway, Arif, A. 2002. A textbook of Agri-Business Management.
4. Indian Agriculture and Agri-business Management, Dr. Smita Diwase, Krishi Resource Management network.
5. Fundamentals of Agribusiness Finance by Ralph W. Battles and Robert C. Thompson.
6. Farm Business Management: The Fundamentals of Good Practice by Peter L Nuthall.
7. Agri-business and Market Management by Amod Sharma.

Web-References:

1. www.ediindia.org
2. www.iie.nic.in
3. www.msme.gov.in
4. www.niesbudtraining.org
5. www.nimsme.org

6. www.nsic.co.in
7. www.nabard.org

Journals:

1. Agricultural Finance Review
2. Canadian Journal of Agricultural Economics
3. Journal of Agricultural Economics Research
4. American Journal of Environmental and Resource Economics

Course No.	:	AEN 401
Course Title	:	Sericulture
Credit Hours	:	3+1
Course Category	:	Elective Course

Course Learning Rationale / Course Objective (CLR):

1. To enhance the skill on moriculture, grainage technology and silkworm rearing
2. To study about the pests, diseases of silkworm and their management
3. To know about the post cocoon technology of mulberry silkworm
4. To study the about the non- mulberry silkworm

Course Learning Outcomes (CLO):

1. Develop practical skills on moriculture, grainage technology and silkworm rearing
2. Identify and manage major pests and diseases of mulberry and silkworm
3. Understand the post-cocoon processing techniques in mulberry silkworm
4. Understand the rearing techniques of non mulberry silkworm

THEORY

Unit 1: Moriculture

Importance, History and development of sericulture in India. Morphology and botanical aspects of mulberry plant. Mulberry breeding and genetics. Methods of propagation in mulberry plants. Mulberry nursery and their management. Mulberry varieties. Weeds in mulberry and their management. Nutritional deficiency in mulberry and their management. Pruning, harvesting and preservation of mulberry leaves. Pests and diseases of mulberry and their management

Unit 2: Morphology and Classification of mulberry silkworm

Morphology and biology of mulberry silkworm. Anatomy and physiology of mulberry silkworm. Mulberry silkworm - origin - classification based on voltinism, moultnism, geographical distribution and genetic nature. Characters of multivoltine races, bivoltine races, cross breeds and bivoltine hybrids - double hybrids- suitability for rearing in different seasons. Rearing house and rearing appliances.

Unit 3: Grainage technology and Rearing techniques

Disinfectant and disinfection methods in rearing house, larval rearing and grainage. Automation in disinfection of silkworm rearing house. Grainage technology - equipments used in silkworm egg production -techniques adopted in grainages to produce quality silkworm eggs. Loose egg preparation. Handling of silkworm eggs. Model grainage plans for production of silkworm eggs. Methods of rearing for chawki silkworm and late age silkworm. Pests and diseases of mulberry silkworm and their management.

Unit 4: Post cocoon technology

Mounting, harvesting and marketing of cocoon. Quality cocoon production for gradable silk. Post-cocoon technology - selection of cocoons, methods of stifling and cooking for different races. Reeling devices - charka, cottage basin and multi end reeling machine - advantages - re-reeling - twisting, degumming, dyeing and weaving. Mechanization in sericulture.

Unit 5: Non-mulberry silkworm

Morphology, biology, host plants and rearing techniques of eri silkworm, tasar silkworm, muga silkworm. Mulberry and silkworm byproducts and their uses. Sericulture as a component of integrated farming system. Biotechnological advances in sericulture. Economics and constraints of silk production.

Theory - Lecture Schedule

1. Importance, History and development of sericulture in India
2. Morphology and botanical aspects of mulberry plant
3. Methods of propagation of mulberry plants
4. Mulberry nursery and their management
5. Main field preparation for establishment of irrigated mulberry garden
6. Main field preparation for establishment of rainfed mulberry garden
7. Mulberry breeding and genetics
8. Mulberry varieties and their salient features
9. Weeds of mulberry and their management
10. Nutritional deficiency in mulberry and their management
11. Pruning, harvesting and preservation of mulberry leaves
12. Raising mulberry garden exclusive for young age silkworm rearing
13. Reclamation of problematic soils in mulberry cultivation
14. Biofertilizers for quality mulberry leaf production
15. Preparation of compost using sericulture waste

16. Pests of mulberry and their management
17. Diseases of mulberry and their management
18. Morphology and biology of mulberry silkworm
19. Anatomy of digestive system- physiology of digestion and excretion - silk gland - Silk synthesis - Physicochemical properties of silk
20. Mulberry silkworm - origin - classification based on voltinism, moultnism, geographical distribution and genetic nature
21. Characters of multivoltine races, bivoltine races, cross breeds and bivoltine hybrids - double hybrids- suitability for rearing in different seasons
22. Rearing house and rearing appliances
23. Disinfectant and disinfection methods in rearing house, rearing appliances, larval rearing and grainage
24. Automation in disinfection of silkworm rearing house

25. Mid Semester Examination

26. Grainage technology - Equipments used in silkworm egg production
27. Grainage technology - Techniques adopted in grainages to produce quality silkworm eggs - selection of cocoon, mother moth examination.
28. Grainage technology - Loose egg preparation - Handling of silkworm eggs
29. Model grainage plans for production of silkworm eggs
30. Methods of rearing - chawki silkworm - Egg transportation and incubation methods - black boxing. Concepts of Community Chawki Rearing Centres (CRC)
31. Rearing of late age silkworms - Different methods - Floor, shelf and shoot feeding, cleaning, spacing.
32. Mounting - different mountages - merits and demerits -spinning - harvesting and marketing of cocoon
33. Pests of mulberry silkworm and their management
34. Diseases of mulberry silkworm and their management
35. Quality cocoon production for gradable silk
36. Post-cocoon technology - selection of cocoons - stifling - cooking
37. Reeling devices - charka - cottage basin - multi end reeling machine - advantages - re-reeling - twisting - degumming - dyeing - weaving - SMOI
38. Mechanization in sericulture
39. Morphology biology and host plants of eri silkworm
40. Rearing techniques of eri silkworm
41. Morphology, biology and host plants of tasar silkworm
42. Rearing techniques of tasar silkworm
43. Morphology, biology and host plants of muga silkworm
44. Rearing techniques of muga silkworm
45. Mulberry and silkworm byproducts and their uses
46. Sericulture as a component of integrated farming system
47. Biotechnological advances in sericulture
48. Economics and constraints of silk production

Practical

Morphology of mulberry plants. Identification of popular mulberry genotypes. Nursery bed, main field preparation and planting methods. Identification of weeds and nutrient deficiency symptoms in mulberry. Different methods of Pruning and harvesting. Identification of pests and diseases of mulberry. Morphology of mulberry silkworm. Identification of races. Dissection of mouth parts and silk glands. Disinfection techniques. Rearing methods of chawki and late age silkworm. Identification of pests and diseases of silkworm. Grainage technology. Post cocoon technology. Non-mulberry silkworms, morphology, biology, hosts plants and rearing methods. Visit to rearing unit, grainage, cocoon market, silk reeling centre.

Practical Schedule

1. Morphology of mulberry plant - description - leaf - types - distinguishing characters of promising mulberry genotypes.
2. Nursery bed preparation - care in selection of planning materials - biofertilizer treatment in nursery - main field preparation - methods of planting.
3. Identification of nutrient deficiency symptoms and their corrective measures. Identification of weeds.
4. Pruning methods, harvesting and preservation of leaves.
5. Identification of different stages of pests of mulberry.
6. Identification of symptoms of diseases of mulberry.
7. Morphology of silkworm - different stages - Identification of races by cocoon shape, colour and larval marking - Dissection of mouth parts and silk glands.
8. Rearing house and appliances - Methods of disinfection.
9. Incubation of eggs - methods - acid treatment of eggs - Chawki rearing - brushing - feeding.
10. Late age silkworm rearing - methods - feeding - cleaning, mounting and cocoon harvest.
11. Identification of pests and diseases of silkworm - Mass multiplication of hyperparasitoid.
12. Grainage technology - equipments used in silkworm egg production - loose egg production - methodology - handling of eggs
13. Post cocoon technology - selection of cocoons - stifling - cooking- reeling- reeling - twisting - degumming - dyeing - weaving
14. Economics of silkworm rearing.
15. Non mulberry silkworm - Morphology, biology, host plants and rearing techniques
16. Visit to silkworm rearing unit/grainage/ cocoon market/silk reeling centre
- 17. Final Practical Examination**

Suggested Readings:

1. Dandin, S. B., J. Jayaswal and K. Giridhar. 2003. Hand book of Sericulture Technologies. Central Silk Board, Bangalore.
2. FAO. 1987. Manual on Sericulture, FAO Agricultural Services Bulletin, Rome.

3. Ganga, G. and J. Sulochana Chetty. 2022. An Introduction to Sericulture. Oxford and IBH publication, New Delhi.
4. Narasimhanna, M. N. 1988. Manual on Silkworm Egg Production. Central Silk Board, Bangalore.
5. Singh, T. and B. Saratchandra. 2004. Principles and techniques of silkworm seed production. Discovery publishing house, New Delhi.

Course No.	:	AEX 401
Course Title	:	Agricultural Journalism
Credit Hours	:	3+1
Course Category	:	Elective Course

Course Learning Rationale / Course Objective (CLR):

1. To acquaint the students with the concepts of Journalism and how to write the agricultural news for print and electronic media for effective transfer of technology.
2. To impart knowledge on Agricultural Journalism and its role in agricultural development.
3. To inculcate skills in script writing for different media.
4. To gain knowledge about the photo journalism
5. To understand the role of social media in agricultural journalism

Course Learning Outline (CLO):

1. Describe the concepts of Journalism and agricultural journalism.
2. Gain knowledge and skills in writing Agricultural News stories, feature stories and their evaluation.
3. Develop knowledge on print media, electronic media and photo journalism.
4. Develop skill in evaluation and measurement of readability of written News articles and feature stories.
5. Acquire skill in preparation of radio and TV scripts

THEORY

Unit 1: Journalism – Meaning, Types and History

Journalism – Meaning, nature, importance, and types of journalism. Agricultural Journalism Meaning, definition, principle, objectives, types, and scope. Similarities and difference between agricultural journalism and other types of journalism. Role of agricultural journalist, Training of agricultural journalist. Qualities of journalist, Role of journalist / journalism in agricultural development and development of newspaper and magazines readers.

Unit 2: Newspapers and Magazines, Gathering Information

Newspaper and magazines as communication media: Characteristics, kinds and functions of newspaper and magazines, Characteristics of newspaper and magazines readers. Form, content, style and language of newspaper and magazines, Standard part of newspaper and magazines. The agricultural story: Types of Agriculture stories, subject matter of the agricultural story, structure of the agricultural story. Gathering farm information-Sources of farm information: abstracting from research and scientific materials, interviews, coverage of events. Other sources: electronic media, field study.

Unit 3: Writing of Success stories, News stories, Readability Measures

Success stories-definition, nature, components, guidelines of writing a success story. Writing a news story difference between news and feature story, the principle of writing a news story, Inverted pyramid structure. Organizing the material, treatment of the story, writing the news lead and the body. Readability measure-readability ease score, automated readability index, gunning fog index, How to improve readability of articles and stories.

Unit 4: Editing of News

Use of art work (Graphs, charts maps, etc.). Writing the captions. Editorial mechanism: Copy reading, head line and title writing. Proof reading: definition, signs and symbols of proof reading, level of proof reading, duties of a proof-reader. Layout meaning, principles of layout and design.

Unit 5: Ethics of Journalism, News Agencies

Ethics of Journalism - News agency - History, functioning & role of PTI and UNI, International News Agencies: AP, UPI, Reuters. Syndicate. Freedom of Press: its basic principles and constraints - Responsibilities and Criticism. Press Council of India (PCI).

Theory – Lecture Schedule

1. Journalism – Meaning, Definition and Nature.
2. Scope and Importance of Journalism
3. Types of Journalism (News Journalism, Advocacy Journalism, Broadcast Journalism, Photo Journalism, Citizen Journalism, Investigative Journalism, Sports Journalism, Environmental Journalism, Literary Journalism, Science Journalism, Music Journalism, Celebrity Journalism, Yellow Journalism, Tabloid Journalism, Agricultural Journalism, Gonzo Journalism)
4. Agricultural Journalism - Meaning, Definition and Objectives
5. Principles of Agricultural Journalism, Role and Responsibilities of Agricultural Journalists in Society
6. Types, Scope and Importance of Agricultural Journalism
7. Similarities and Differences between Agricultural Journalism and other types of Journalism
8. Training and Skill Development for Agricultural Journalists
9. Qualities of Journalists (Reporters)
10. Role of Journalism and Journalist in Agricultural Development

11. Role of Newspapers and Magazines in Agricultural Development Developing Newspaper and Magazine Readers
12. Newspapers and Magazines as communication media: Characteristics and Kinds (dailies, weeklies, fortnightly, monthly, etc.,) and Functions of Newspapers and Magazines
13. Characteristics of Newspaper and Magazine Readers
14. Form, Content, Style and Language of Newspapers and Magazines
15. Standard Parts of Newspapers (General news, Local / regional and foreign news, Editorial Page, Sports page, Classified Ads, Letters to the Editor, Op –ed Page)
16. Standard Parts of Magazines (Cover Page, Table of Contents, Editor’s Letter, Special Features)
17. Agricultural Stories and its Types.
18. Importance of subject matter for Agricultural Stories.
19. Structure of an Agricultural Story (Inverted pyramid - news story and pyramid (feature story)
20. Gathering Farm Information – Sources of Information (Abstracting from Research and Scientific Materials)
21. Gathering information from other sources (Electronic media and Field Study)
22. Interviews and Coverage of Events
23. Online Journalism – Features, Principles and Technologies
24. Online Multimedia Tools for Journalism
25. **Mid Semester Examination**
26. Success stories: Definition, Nature, Components and Guidelines for Writing Success Stories
27. News - Definitions, principles of News, Types of News
28. News Value
29. Principles of Writing a News Story - Writing a News Story - Structure of News story - Inverted Pyramid
30. Organising a material and Treatment of story: Lead and its Types, Body of News Stories
31. News Headlines and its types
32. Feature story and its types - Difference between News story and Feature Story
33. Script writing for Radio
34. Script writing for TV
35. Readability Measures –Definition and Readability Ease Score
36. Automated Readability Index and Gunning Fog Index
37. Steps to improve Readability of Articles and Stories
38. Photography–Use of photography in Agricultural Journalism
39. Qualities and responsibilities of photo journalist
40. Basic Principles of Photography - Composition, Exposure, Lens, and Light Picture editing and writing captions, Photo feature and Photo Essay
41. Use of Artwork - Graphs, Charts and Maps in Journalism

42. Editing—Principles of editing, Qualities of good editor - Functions of Editorial desk.
43. Editorial Mechanism – Copy reading, Headline and Title Writing
44. Proof reading - definition and signs, symbols, levels of proofreading and duties of proof reader.
45. Layout and Balancing - Meaning, Principles of Layout and Design
46. Ethics of Journalism
47. News agency - History, functioning & role of PTI and UNI, International News Agencies: AP, UPI, Reuters. Syndicate.
48. Freedom of Press: its basic principles and constraints - Responsibilities and Criticism. Roles and Functions of Press Council of India (PCI)

Practical

Practice in writing an agricultural news story. Practice in writing an agricultural feature story. Covering agricultural events for the information collection. Practice in interviewing for the information collection. Abstracting stories from research and scientific materials and wire services. Selecting pictures and artwork for the agricultural story. Practice in editing, copy reading. Practice in headline and title writing. Practising proof reading. Practice in lay outing of newspaper. Testing copy with a readability formula. Visit a publishing office.

Practical Schedule

1. Covering agricultural events for writing a news story
2. Practice in writing an Agricultural News Story
3. Covering agricultural events for writing a feature story
4. Practice in writing a Feature Story with respect to agriculture
5. Practice in interviewing for information collection and Preparation of news item
6. Visit to a Press to learn printing technology
7. Abstracting Stories from Research, Scientific Materials and Wire Services
8. Capturing photographs for news story/feature story related to agriculture and caption writing
9. Selecting Pictures and Artwork for Photo Essay and Photo Feature
10. Practice in editing an article with proof reading symbols; formation of headline/title.
11. Preparing a radio script.
12. Visit to newspaper organisation to learn its role and functions.
13. Practice in writing Success Stories for print media
14. Practicing in preparing layout for Newspaper
15. Testing the published article with readability formula
16. Practice in preparing and publishing online news
- 17. Final Practical Examination**

Suggested Readings:

1. Handbook of Journalism and Mass Communications-VirBala Aggarwal & V.S. Gupta
2. The Professional Journalism - M. V. Kamath
3. News Writing - George Hough (Indian edition by Kanishka Publishers, No. 4697/5-21A. Ansari Road. Daryaganj, New Delhi – 110 002. Ph. 3270497.3288285. Fax no.: 3288285).
4. Theory and Practice of Journalism – B.N. Ahuja – Surjeet Publications – New Delhi.
5. News Editing - Bruce II. Westley
6. Radio and TV Journalism- Jan R Hakemulder, PP Singh, Fay AC DE Jonge
7. Radio and TV Journalism – K.M. Srivastava
8. Photo journalism: the professional approach-Kenneth cobre 2. Basic photography –Michael Langford
8. Press in the Indian Constitution R K Ravindran 3. Principles & Ethics of Journalism Dr. Jan R Hakemuldar, Dr. Fay AC de Jouge, P P Singh
9. Ethics & Journalism –Karen Sanders

Course No.	:	AGM 401
Course Title	:	Bio-pesticides and Bio-fertilizers
Credit Hours	:	3+1
Course Category	:	Elective course

Course Learning Rationale / Course Objective (CLR):

1. To understand the principles and functioning of bio-control agents in managing plant diseases.
2. To explore various methods used for applying bio-control agents in agriculture.
3. To examine the mechanisms by which bio-control agents suppress pathogens and enhance plant health.
4. To gain knowledge on biofertilizers types and their applications in sustainable agriculture.
5. To learn the mechanisms by which biofertilizers improve soil fertility and promote plant growth.

Course Learning Outcomes (CLO):

1. Understand how bio-control agents work to manage plant diseases.
2. Apply knowledge on bio-control methods to protect plants and improve their health.
3. Analyse the role of biofertilizers in sustainable agriculture and their impact on soil fertility and plant growth.

4. Evaluate different types of biofertilizers, applications, and their effectiveness in improving agricultural productivity.
5. Develop practical knowledge of bio-control and biofertilizers to protect crops and improve soil health.

THEORY

Unit 1: Biocontrol control – Concepts and Microbial Biopesticides

History– Definitions – Concepts – Importance of Biological Disease Management, Mechanisms of Biocontrol – Direct and Indirect – Suppressive and Conducive Soils – Competitive Saprophytic Ability (CSA), Biopesticides – Definitions –Types – Microbial– Botanical – Biochemical – PIPs, Microbial Biopesticides – Ideal Traits – *Fungal biopesticides* – antagonistic fungi and entomopathogenic fungi, *Bacterial biopesticides* – antagonistic bacteria and entomopathogenic bacteria, *Viral biopesticides* – Nucleopolyhedroviruses (NPVs), Granuloviruses (GVs), *Nematode based biopesticides* – entomopathogenic nematodes (EPNs) - *Heterorhabditis*, *Steinernema* spp., *Protozoan biopesticides* – *Nosema* spp., Morpho-molecular characterization of biocontrol agents - Fungal antagonists - *Trichoderma asperellum*, *Verticillium lacanii*, *Beauveria bassiana*, *Metarhizium anisopliae*, *Chaetomium globosum* and *Coniothyrium minitans* - Bacterial antagonists - *Pseudomonas fluorescens* and *Bacillus subtilis*, *In vitro* antagonistic activity – Compatibility with agrochemicals - other antagonistic and plant growth promoting microbes, Formulations – Quality control – shelf-life – Delivery methods – *T. asperellum*, *M. anisopliae*, *P. fluorescens*, *B. subtilis*, Factors affecting efficacy.

Unit 2: Botanical biopesticides, Biochemical biopesticides, PIPs and Advanced approaches

Botanical biopesticides – Neem products – mechanisms – formulations – commercial products, Antiviral principles – preparation and application methods, Biochemical biopesticides – definition – classification – semiochemicals – pheromones – kairomones – mode of action – methods of application – commercial products, Plant incorporated protectants (PIPs) – definition – expression in plants – mode of action – advantages and limitations – commercial crops – Regulatory framework – registration – approval – CIBRC – Nanotechnology and Biotechnology approaches for enhanced efficacy.

Unit 3: Introduction to Biofertilizers and Nitrogen Fixation

Agriculturally important beneficial Microorganisms. Introduction and scope of Biofertilizers. Types and classification of Biofertilizers. Nitrogenous based Biofertilizers. Symbiotic and Non-Symbiotic Nitrogen fixation. Rhizobium and Azotobacter biofertilizers Mechanism of Nodule formation, Competitiveness, Quantification of Nitrogen fixed. Actinorhizal symbiosis – systematic position, Actinorhizal plants, infection process, nodule development and isolation of Frankia. Nitrogenous based Biofertilizers: Associative and endophytic Nitrogen fixation. Azospirillum and Gluconacetobacter - Characteristics, their significance and utilization in agriculture. Cyanobacterial Biofertilizers - Anabaena, Nostoc, Hapalosiphon. Scaling and mass production techniques of BGA Biofertilizers.

Unit 4: Phosphorus, Potassium, and Zinc Biofertilizers

Phosphate solubilising Bacteria and Fungi. Mechanism and solubilization of Phosphorus. Taxonomy, occurrence, distribution, mechanism, isolation and identification of Arbuscular Mycorrhizal fungi. Scaling and mass production techniques of VAM fungal biofertilizer and crop response. Potassium and Zinc Biofertilizers - Characteristics, their significance and utilization in agriculture. Plant Growth Promoting Biofertilizers (PGPR)

Unit 5: Production technology

Production technology: Strain selection, Sterilization, Growth and Fermentation. Fermenters: Types, functions, design and control. Mass scale production of different carrier and liquid based biofertilizers. Microbes beneficial for recycling of Organic wastes & Composting. Bio-remediators and its related Microbes. Biofertilizers –Storage, shelf life and marketing. Factors influencing the efficacy of Biofertilizers; Application technology for seeds, seedlings, tubers, sets etc. Azolla - Characteristics, physiology, significance and their utilization in agriculture; Scaling and mass production techniques of azolla. Nano-biofertilizers: Synthesis, advantages, and applications. FCO specifications and quality control of biofertilizers. National Centre of Organic Farming (NCOF)- objectives and functions; Fertilizer (Control) Order (FCO), 1985- Regulatory framework outline

Theory - Lecture Schedule

1. History definition, concepts and classification of botanicals, biorationals and their uses in pest management
2. Virulence, pathogenicity and symptoms of entomopathogenic virus
3. Virulence, pathogenicity and symptoms of entomopathogenic bacteria, protozoan and rickettsiae
4. Virulence, pathogenicity and symptoms of entomopathogenic fungi and quality control of entomopathogens.
5. Impediments and limitation in production and use of biopesticides.
6. History, definition, concepts and importance of biocontrol control.
7. Direct and indirect mechanisms of biological control, suppressive and conducive soil, competitive saprophytic ability (CSA).
8. Definitions and classes of biopesticides - Microbial biopesticides, Botanical biopesticides, Biochemical biopesticides and Plant incorporated protectants (PIPs).
9. Microbial biopesticides - ideal characters and types of biocontrol agents - fungal biopesticides, bacterial biopesticides, viral biopesticides, nematode based biopesticides and Protozoan biopesticides.
10. Microbial biopesticides - Morpho-molecular characterization of fungal and bacterial biocontrol agents.
11. Assessing the *in vitro* antagonistic activity of biocontrol agents.
12. Compatibility of bio-agents with agrochemicals and other antagonistic and plant growth promoting microbes.
13. Formulations, quality control standards and shelf-life of microbial biopesticides.
14. Delivery methods of microbial biopesticides - *Trichoderma asperellum*, *Metarhizium anisopliae*, *Pseudomonas fluorescens* and *Bacillus subtilis*.

15. Factors affecting the efficacy of microbial biopesticides.
16. Botanical biopesticides - mode of action, preparatory techniques, formulations, application methods and commercial products of neem based biopesticides.
17. Botanical biopesticides - preparation and application methods of antiviral principles.
18. Biochemical biopesticides – definition, classification, mode of action, methods of application and commercially available products.
19. Plant incorporated protectants (PIPs) - definition, expression of PIPS in plants, mode of action, commercially available PIP crops, advantages and limitations,
20. Regulatory framework for biopesticides - registration and approval process overseen by the Central Insecticides Board and Registration Committee (CIBRC), key regulatory agency in India.
21. Nanotechnology approaches for enhanced efficacy of biopesticides.
22. Biotechnology approaches for enhanced efficacy of biopesticides.
23. Agriculturally important beneficial Microorganisms. Introduction and scope of Biofertilizers.
24. Types and classification of Biofertilizers. Total Biofertilizer production in India and Tamil Nadu

25. Mid Semester Examination

26. Nitrogenous based Biofertilizers. Symbiotic & Non-Symbiotic Nitrogen fixation.
27. Rhizobium and Azotobacter biofertilizers - Characteristics, their significance and utilization in agriculture.
28. Mechanism of Nodule formation, Competitiveness, Quantification of Nitrogen fixed.
29. Actinorhizal symbiosis – systematic position, Actinorhizal plants, infection process, nodule development and isolation of Frankia
30. Nitrogenous based Biofertilizers: Associative and endophytic Nitrogen fixation.
31. Azospirillum and Gluconacetobacter - Characteristics, their significance and utilization in agriculture.
32. Cyanobacterial Biofertilizers - Anabaena, Nostoc, Hapalosiphon.
33. Scaling and mass production techniques of BGA Biofertilizers
34. Phosphate solubilising Bacteria and Fungi. Mechanism and solubilization of Phosphorus
35. Taxonomy, occurrence, distribution, mechanism, isolation and identification of Arbuscular Mycorrhizal fungi.
36. Scaling and mass production techniques of VAM fungal biofertilizer and crop response.
37. Potassium and Zinc Biofertilizers - Characteristics, their significance and utilization in agriculture.
38. Plant Growth Promoting Biofertilizers (PGPR)
39. Production technology: Strain selection, Sterilization, Growth and Fermentation.
40. Fermenters: Types, functions, design and control

41. Mass scale production of different carrier and liquid based biofertilizers.
42. Microbes beneficial for recycling of Organic wastes & Composting.
43. Bio-remediators and its related Microbes.
44. Biofertilizers –Storage, shelf life and marketing. Factors influencing the efficacy of Biofertilizers; Application technology for seeds, seedlings, tubers, sets etc.
45. Azolla - Characteristics, physiology, significance and their utilization in agriculture; Scaling and mass production techniques of azolla.
46. Nano-biofertilizers: Synthesis, advantages, and applications
47. FCO specifications and quality control of biofertilizers.
48. National Centre of Organic Farming (NCOF)- objectives and functions; Fertilizer (Control) Order (FCO), 1985- Regulatory framework outline

Practical

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

Practical Schedule

1. Identification of botanicals for pest management
2. Identification of entomopathogenic microorganism infected cadavers in field condition
3. Mass production of entomopathogens
4. Preparation of culture media and isolation of biocontrol agents - *Trichoderma asperellum*, *Metarhizium anisopliae*, *Pseudomonas fluorescens* and *Bacillus subtilis*.
5. Assessing the *in vitro* antagonistic activity of biocontrol agents.
6. Mass multiplication of fungal biocontrol agents - *Trichoderma asperellum* and *Metarhizium anisopliae*.
7. Mass multiplication of bacterial biocontrol agents - *Pseudomonas fluorescens* and *Bacillus subtilis*.
8. Isolation of Nitrogen fixing organisms *Rhizobium*, *Azotobacter*.
9. Isolation of Phosphate solubilising mobilizing microbes from soil sample.
10. Development & production of efficient Microbes. Preservation and pure cultures development.
11. Study of Nitrogen fixing Activity by ARA method.
12. Production of Indole Acetic Acid (IAA).
13. Production of Siderophores.
14. Preparation of different Carrier and Liquid based Biofertilizers.

15. Study the Quality parameters of Biofertilizers
16. Visit to commercial Biofertilizer and biocontrol production unit
- 17. Final Practical Examination**

Suggested Readings:

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

Course No.	:	AGM 402
Course Title	:	Applied Microbiology
Credit Hours	:	3+1
Course Category	:	Elective course

Course Learning Rationale / Course Objectives (CLR):

1. To understand the principles and factors influencing microbial spoilage and preservation of food.
2. To explore the role of microorganisms in dairy and fermented food products, as well as their industrial applications.
3. To examine microbial contributions to biotechnology, including the production of metabolites and bioactive compounds.
4. To study the impact of microbes in health, environmental sustainability, and bioremediation processes.
5. To analyse microbial applications in recombinant DNA technology and bioenergy production.

Course Learning Outcome (CLO):

1. Develop basic knowledge on microbial growth and spoilage in food systems.
2. In-depth understanding of microbial applications in dairy, fermentation, and industrial processes.
3. Apply knowledge on microbial roles in health and environmental management.
4. Gain insights into microbial genetic engineering and its relevance in biotechnology.
5. Students will be able to assess microbial contributions to sustainable energy production.

THEORY

Unit 1: Food spoilage and preservation

Food microbiology – History, scope and significance; Microbial diversity – bacteria, yeasts and Molds; Microbial growth factors – Temperature, pH, Nutrients; Microbial spoilage – causes and dynamics; Factors affecting microorganisms – Intrinsic & Extrinsic; Biofilms and microbial adaptations; Physical and chemical preservation methods;

Unit 2: Food borne pathogens and contaminants

Food poisoning, intoxication; Pathogenic bacteria – *Salmonella*, *Listeria*, *E. coli*, *Clostridium*; Viral contaminants – Norovirus, Hepatitis A, Rotavirus; Mycotoxins and foodborne fungi; Emerging foodborne threats – prions and zoonotic microbes; Rapid detection methods – Real-Time PCR, ELISA.

Unit 3: Microbes in food and Fermentation microbiology

Microbes in meat, seafood, cereal-based foods; Microbes in fruits, vegetables, milk; Spoilage of milk; Fermented milk products; Fermented foods - sauerkraut, kefir, miso, etc.; Fermentation of tea, coffee, cocoa; Production of single cell protein; Food nanotechnology and microbial biosensors

Unit 4: Industrial Microbiology

Alcoholic and distilled beverages; Organic acids - citric, acetic; Amino acids - glutamic acid, lysine, tryptophan; Enzymes – amylase, protease; Vitamins - B12, Riboflavin; Antibiotics - types, penicillin; Polysaccharides, pigments, phytohormones; Probiotics, prebiotics, synbiotics, Gut microbiota and nutrition,

Unit 5: Environmental Microbiology and Microbial Biotechnology

Biotransformation and agrowaste biodegradation, Composting – types and microbial succession; Bioremediation and biomining; Genetic engineering – vectors, plasmids; Recombinant DNA products; Biofuels, biogas, hydrogen, electricity production

Theory - Lecture Schedule

1. Food microbiology – History, scope and significance
2. Microbial diversity in food systems – bacteria, yeasts and Molds
3. Microbial growth factors – Temperature, pH and Nutrients
4. Microbial spoilage of foods-cause and ease of spoilage
5. Factors affecting microorganisms in food-Intrinsic factors
6. Factors affecting microorganisms in food-Extrinsic factors
7. Biofilms and microbial adaptations in food environments
8. Principles of food preservation-physical methods
9. Principles of food preservation-chemical methods
10. Food poisoning, intoxication
11. Pathogenic bacteria – *Salmonella*, *Listeria*, *E. coli*, *Clostridium*
12. Viral contaminants – Norovirus, Hepatitis A & Rota virus
13. Mycotoxins and food borne fungi – Aflatoxins and Ochratoxins
14. Emerging foodborne threats – Prions and zoonotic microbes
15. Rapid detection methods for microbes in food- Real-Time PCR, ELISA
16. Case studies on major foodborne outbreaks
17. Microbes in meat-contamination and preservation
18. Microbes in seafood-contamination and preservation
19. Microbes in cereal-based foods -contamination and preservation
20. Microbes in fruits and vegetables -contamination and preservation
21. Microbes in milk-contamination and preservation
22. Spoilage of milk
23. Fermented milk products
24. Fermented Foods-Sauerkraut, kefir, tempeh, miso etc.,
25. **Mid semester examination**

26. Fermentation of tea, coffee and cocoa
27. Production of single cell protein
28. Advances in food nanotechnology and microbial biosensors
29. Production of alcoholic beverages-beer, wine
30. Production of distilled alcoholic beverages
31. Microbial production of organic acids-citric acid, acetic acid
32. Microbial production of amino acids-glutamic acid, lysine, tryptophan
33. Microbial production of enzymes-amylase, protease
34. Microbial production of vitamins-B12, Riboflavin
35. Microbial production of antibiotics- types, penicillin production
36. Microbial polysaccharides
37. Microbial phytohormones and pigments
38. Probiotics-importance, application.
39. Prebiotics and synbiotics
40. Gut Microbiota and its influence on Nutritional metabolism
41. Microbial biotransformation-types and significance
42. Biodegradation of agrowastes-composting types
43. Microbiology of composting-succession of microbes during composting.
44. Bioremediation-importance, degradation of oils, xenobiotic compounds; Biomining
45. Microbes in genetic engineering-vectors, plasmids, transposons
46. Recombinant DNA products using microbes
47. Biomass to biofuel-ethanol production, biogas generation
48. Hydrogen production, electricity generation

Practical

Enumeration of microorganisms in food, Microbiological examination of spoiled meat/fish, milk and milk products; Fermented products-Wine making, Sauerkraut preparation; Isolation of probiotic microorganism-LAB from curd/idli batter; Isolation of yeast from fruit juice; Isolation of *Acetobacter aceti* 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.

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 aceti* 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**

Suggested Readings:

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.

Course No.	:	AGR 401
Course Title	:	System Simulation and Agro-Advisory
Credit Hours	:	3+1
Course Category	:	Elective course

Course Learning Rationale / Course Objectives (CLR):

1. To impart the knowledge of statistical and simulation modelling in crop yield estimation
2. To get acquainted with different weather forecasting techniques and their usability analysis
3. To study about the preparation and dissemination of agro-advisory bulletin

Course Learning Outcome (CLO):

1. Understanding the fundamentals of Modelling
2. Knowing the basics of agro advisories.
3. Knowledge on Basics of modelling for agro advisory preparation.
4. Understanding the concepts of simulation for agro advisories.

THEORY**Unit 1: Systems and concepts**

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 2: Models

Validation of models Evaluation of crop responses to weather elements; Elementary crop growth models; calibration, validation, verification and sensitivity analysis.

Unit 3: Techniques of modelling

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 4: Weather forecasting

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 5: Agro advisories

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.

Theory - Lecture Schedule

1. System–definition –boundaries-concepts.
2. Models-definition-scope.
3. Soil-plant-atmospheric continuum
4. SPAC- impact on model
5. Model-boundaries–inputs
6. Models limitations- constrains
7. Crop models, concepts and techniques
8. Types of crop models
9. Abstract models

10. Simulation Models.
11. Input and output data requirements for models.
12. Inter relationship of models.
13. Evaluation of crop responses to weather elements;
14. Elementary crop growth models
15. Calibration of models
16. Validation of models
17. Verification of models.
18. Sensitivity analysis of models.
19. Potential yields
20. Achievable yields
21. Concept and modelling techniques for estimation of yields
22. Crop production in moisture stress conditions
23. Crop production in nutrients limited conditions;
24. Components of soil water and nutrients balance.
25. **Mid Semester Examination**
26. Weather forecasting- definitions- scope
27. Components of weather forecasting
28. Types and methods of weather forecasting and tools
29. Techniques of weather forecasting
30. Forecast verification techniques
31. Nowcasting and its application.
32. Short range weather forecasting
33. National Centre for Medium Range Weather Forecasting (NCMRWF)
34. Agro Meteorological Field Units (AMFU).
35. Gramin Krishi Mausam Sewa (GKMS)
36. District Agromet field Units (DAMU)
37. Seasonal climate forecast
38. Long Range Weather Forecasting (LRF)
39. Role in weather forecasting in farming.
40. ITK Definition
41. ITK and its role in weather forecast and validity
42. Preparation of agro-advisory bulletin based on weather forecast.
43. Use of crop simulation model for preparation of Agro-advisory
44. Dissemination of weather forecasting and its mode.
45. Crop-Weather Calendars
46. IMD and its role in weather forecasting.
47. RMC- its role in weather forecasting.
48. Websites and information on weather forecasting.

Practical

Preparation of crop weather calendars. Preparation of agro-advisories based on weather forecast using various approaches and synoptic charts. Working with statistical and simulation models for crop growth. Potential and achievable production; yield forecasting, insect and disease forecasting models. Simulation with limitations of water and nutrient management options. Sensitivity analysis of varying weather and crop management practices. Use of statistical approaches in data analysis and preparation of historical, past and present meteorological data for medium range weather forecast. Feedback from farmers about the agro- advisory.

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. Final Practical Examination**

Suggested Readings:

1. Introduction to Agrometeorology by H. S. Mavi.
2. Introductory Agrometeorology. p.149. by Narayanan. A L. 2021. Brillion Publishing. 22B/5 Ground floor, Desh Bandhu Gupta Road, Karol Bagh, New Delhi 110005. ISBN:978-93-86658-32-3.
3. Agricultural Meteorology by G.S.L.H.V. Prasado Rao.
4. Advances in Plant Atmospheric Interactions (Eds. Rao, V.U.M., Rao, A.V.M.S., Rao, G.G.S.N., Ramana Rao, B.V., Vijaya Kumar, P. and Venkateswarlu, B), Central Research Institute for Dryland Agriculture (CRIDA), Santoshnagar, Hyderabad.
5. Text Book of Agricultural Meteorology by M.C. Varshneya and P.B. Pillai. ICAR.

6. Principles of Agricultural Meteorology by OP Bishnoi.
7. Principles of Applied Agricultural Meteorology, by Narayanan. AL. Sri Velan Pathipagam, Chidambaram.

Web-References:

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

Course No.	:	AGR 402
Course Title	:	Climate Resilient Agriculture
Credit Hours	:	3+1
Course Category	:	Elective course

Course Learning Rationale / Course Objectives (CLR):

1. To impart the concept of climate resilient agriculture under the present context of climate change
2. To study the integrated role of different sectors in building resilience to climate change in agriculture

Course Learning Outcome (CLO):

1. Understanding the climate resilient agriculture
2. Knowing the basics of climate change.
3. Knowledge on Basics of resiliency to mitigate climate change.

THEORY

Unit 1: Climate change concepts

Climate change and impacts of climate change on agriculture and food security; crop productivity under different climate change scenarios including extreme events such as drought, flood, pest and disease outbreak etc.

Unit 2: Mitigation and adaptation

Basics of adaption and mitigation of climate change in the agricultural sectors; analyzing and assessing climate vulnerability to identify vulnerable sectors and possible adaptation options in agriculture; assessing biophysical and socio-economic impacts on agricultural sector; risk assessment strategies, preparedness for weather and climate risks in agriculture; application of geospatial tools and techniques for sustainable agriculture.

Unit 3: Resilience and diversification

Climate resilient agriculture (CRA) – concept, scope and importance with special reference to India, climate resilient technologies for enhancing crop productivity and sustainability Role of weather and climatic information, agro- advisories, ICTs and simulation models; climate resilient agronomic practices – crop/cultivar selection, crop diversification/ crop mixtures; water management practices–rain water harvesting, micro-irrigation, deficit irrigation and drainage management,

Unit 4: Soil and nutrient concepts

Organic/natural farming, integrated farming systems (IFS); site specific nutrient management (SSNM), conservation agriculture technologies to build soil organic carbon, harnessing microbial biodiversity, biomass recycling; use of renewable sources of energy; climate resilient pest-disease management strategies.

Unit 5: Breeding strategies

Breeding strategies for development of climate change resilient crops and varieties, development of biotic and abiotic stress tolerant/resistant cultivars under changed climatic scenarios including extreme weather events.

Theory - Lecture Schedule

1. Climate change- definitions
2. General impacts of climate change
3. Impacts of climate change on crop productivity
4. Impacts of climate change on food security
5. Climate change scenarios – drought
6. Climate change scenarios - flood
7. Climate change scenarios – pest outbreak
8. Climate change scenarios - disease outbreak
9. Adaptation basics of climate change in the agricultural sectors
10. Mitigation basics of climate change in the agricultural sectors
11. Analyzing climate vulnerability to identify vulnerable sectors
12. Assessing climate vulnerable sectors
13. Assessing biophysical impacts climate change on agricultural sector
14. Assessing socio-economic impacts climate change on agricultural sector
15. General Climate change risk assessment strategies,
16. Preparedness for weather and climate risks in agriculture;
17. Application of geospatial tools and techniques for sustainable agriculture.
18. Climate resilient agriculture (CRA) – concept,
19. Scope and importance of CRA with special reference to India,
20. Climate resilient technologies for enhancing crop productivity and sustainability
21. Role of weather and climatic information on crop productivity,
22. AAB

23. AMFU-GKMS
24. ICT – Dissemination
- 25. Mid Semester Examination**
26. Preparation of Agro- advisories,
27. ICTs and simulation models;
28. Climate resilient agronomic practices – crop/cultivar selection,
29. Climate resilient agronomic practices - Crop diversification/ crop mixtures;
30. Climate resilient agronomic practices -water management practices
31. Climate resilient agronomic practices –rain water harvesting,
32. Climate resilient agronomic practices -micro-irrigation,
33. Climate resilient agronomic practices -deficit irrigation
34. Climate resilient agronomic practices - drainage management,
35. Climate resilient agronomic practices - Organic/natural farming,
36. Integrated farming systems (IFS);
37. Site specific nutrient management (SSNM),
38. Role of Conservation Agriculture in Climate resilient agriculture
39. Conservation Agriculture technologies to build soil organic carbon
40. Conservation Agriculture technologies for harnessing microbial biodiversity,
41. Conservation Agriculture in biomass recycling
42. Conservation Agriculture in use of renewable sources of energy
43. Conservation Agriculture in climate resilient pest-disease management strategies.
44. Breeding strategies for development of climate change resilient crops and varieties,
45. Breeding strategies for development of biotic stress tolerant/resistant cultivars
46. Breeding strategies for Abiotic stress tolerant/resistant cultivars under
47. Breeding strategies for extreme weather events.
48. Mitigation of climate scenarios in general

Practical

Acquaintance with meteorological instruments including AWS, Statistical techniques to study trend of climatic parameters, Analysis of extreme weather events using non-parametric tests, Building climate change scenarios under different futuristic emission of GHGs, Designing strategies to mitigate the effect of climate change using climate resilient crops/cultivars, Climate resilient technologies and manipulation of cropping patterns, Acquaintance with ICTs for effective dissemination of local weather information and agro-advisories, Analysing carbon sequestration potential of different agro-ecosystems; Designing climate smart village model considering the availability of resources. Awareness programme on climate change and climate resilient agriculture among farming community.

Practical Schedule

1. Acquaintance with meteorological instruments
2. Acquaintance with AWS
3. Statistical techniques to study trend of climatic parameters,
4. Analysis of extreme weather events using non-parametric tests
5. Building climate change scenarios under different futuristic emission of GHGs,
6. Designing strategies to mitigate the effect of climate change using climate resilient crops/cultivars,
7. Climate resilient technologies and manipulation of cropping patterns,
8. GKMS and its activities
9. Preparation of agro-advisories
10. Acquaintance with ICTs for effective dissemination of local weather information
11. Analysing carbon sequestration potential of different agro-ecosystems;
12. Designing climate smart village model considering the availability of resources for irrigated condition.
13. Designing climate smart village model considering the availability of resources for rainfed condition.
14. Awareness programme on climate change and climate resilient agriculture among farming community.
15. Visiting farmers and collecting feedback about climate change and climate resilient agriculture.
16. Visit to nearby research station to know the climatic resilient activities
- 17. Final Practical Examination**

Suggested Readings:

1. Climate Resilient Animal Agriculture by GSLHV Prasada Rao. NewIndia Publishing Agency.
2. Climate Resilient Agriculture Adaptation and Mitigation Strategies by Bhan Manish. NewIndia Publishing Agency
3. Climate-Smart Agriculture Source book. FAO (2013).
4. Implications for Climate Smart Agriculture by Wahid Hasan, Sachin G.Mundhe, Ansari and Shivani Kumari. Biotech Books, 357p.
5. Climate Resilient Agriculture, Adaptation and Mitigation Strategies by Manish Bhan. New India Publishing Agency, 294p.
6. Climate Change and Agriculture Over India by Prasad Rao. PHILearning, 352p.
7. Climate Smart Agriculture for Sustaining Crop Productivity and Improving Livelihood Security by Prakash M. Satish Serial Publishing House. 178p.

Course No.	:	AGR 403
Course Title	:	Geo-informatics and Remote Sensing, Precision Farming
Credit Hours	:	3 +1
Course Category	:	Elective course

Course Learning Rationale / Course Objectives (CLR):

1. Enabling students acquire knowledge on basics of remote sensing technique for precision farming applications
2. To provide a comprehensive knowledge of remote sensing, precision farming and its benefits in improving crop production and soil health management

Course Learning Outcome (CLO):

1. Enable students to acquire basic knowledge on Geoinformatics and remote sensing techniques
2. Enable students to acquire basic knowledge on precision farming
3. Enable students to familiarize on the use of precision farming tools and techniques

THEORY

Unit 1: Introduction to Remote sensing

Introduction and history of remote sensing; sources, Principles of remote sensing, propagation of radiation in atmosphere; Interaction with matter.

Unit 2: Remote sensing techniques and applications

Application of remote sensing techniques land use soil surveys; crop stress and yield forecasting; Advantages and disadvantages of remote sensing; Remote sensing institutes in India. Hyperspectral and Thermal Remote Sensing; Proximal Soil and Crop Sensors

Unit 3: Geo-informatics and Precision farming concepts

Basic Concepts about geoinformatics, Data sharing; Expert System: Introduction to expert system, Characteristics and features of expert system, Applications of Expert System, Importance of Expert system, Rule based system architecture. Precision agriculture: concepts and techniques; their issues and concerns for Indian agriculture - Spatial data and their management in GIS - Image processing and interpretation - Global positioning system (GPS), components and its functions.

Unit 4: Softwares for Geo-informatics and Precision farming

Software Agents; Impact of Block chain and it's concepts. Basics of Machine Learning: Random Forest, SVM, ensemble methods; Basics of Deep Learning: various model architectures and it's training aspects.

Unit 5: Probability and Statistics tools for Precision farming

Probability and Statistics: Bayes Theorem, correlation and Covariance, Continuous Random variables and probability distribution function, various forms of distributions, central limit theorem.

Theory - Lecture Schedule

1. Introduction and history of remote sensing
2. Sources and Principles of remote sensing
3. Propagation of radiation in atmosphere; Interaction with matter
4. Application of remote sensing techniques land use soil surveys;
5. Advantages and disadvantages of remote sensing; Remote sensing institutes in India.
6. Crop stress and yield forecasting;
7. Hyperspectral and Thermal Remote Sensing; Proximal Soil and Crop Sensors
8. Basic Concepts about geoinformatics
9. Data sharing
10. Expert System: Introduction to expert system, Characteristics and features of expert system.
11. Applications of Expert System, Importance of Expert system, Rule based system architecture
12. Precision agriculture: concepts and techniques
13. PF issues and concerns for Indian agriculture
14. Global positioning system (GPS) – components and its functions
15. Spatial data and their management in GIS
16. Image processing and interpretation
17. Software Agents; Impact of Block chain and it's concepts
18. Basics of Machine Learning: Random Forest
19. Basics of Machine Learning: SVM and ensemble methods
20. Basics of Deep Learning
21. Various model architectures and it's training aspects
22. DSS Model architecture and its aspects
23. Fertilizer prescription model architecture and its aspects
24. Probability theorem
25. **Mid Semester Examination**
26. Bayes Theorem
27. Basic Statistics
28. Forms of distributions
29. Central limit theorem
30. Univariate data analysis
31. Multivariate data analysis
32. Multivariate data analysis
33. Correlation

34. Correlation
35. Regression
36. Regression
37. Covariance analysis
38. Covariance analysis
39. Continuous Random variables
40. Probability distribution function
41. Probability distribution function
42. Probability distribution function
43. Principle Component Analysis - Basics
44. Principle Component Analysis - Basics
45. Principle Component Analysis - Types
46. Principle Component Analysis - Types
47. Principle Component Analysis using software
48. Principle Component Analysis using software

Practical

Familiarization with different remote sensing equipments and data products - Interpretation of aerial photographs and satellite data for mapping of land resources - Global positioning system (GPS) - Basics of Geographic Information System (GIS) - Georeferencing of toposheets - Digital soil mapping with different variables - Basics of multivariate data analytics - Principal component analysis and regression applications, clustering methods and geo-statistics.

Practical Schedule

1. Basics of GPS
2. Basics of GIS
3. Remote sensing equipment - Basics
4. Image processing and interpretation
5. Georeferencing of toposheets
6. Interpretation of aerial photographs and satellite imageries
7. Digitization of soil with different variables
8. Basic probability analysis
9. Basic Statistical analysis – Measures of Central tendency
10. DSS Models – DSSAT and DESSIFER
11. Univariate analysis
12. Multivariate analysis
13. Correlation analysis
14. Regression analysis
15. Principle Component Analysis – Types and interpretation
16. Principle Component Analysis using R software
17. **Final Practical Examination**

Suggested Readings:

1. Data Analytics in Bioinformatics: A Machine Learning Perspective. Editor (s): Rabinarayan Satpathy, Tanupriya Choudhury, Suneeta Satpathy and Sachi Nandan.
2. Machine Learning Approaches to Bioinformatics by Zheng Rong Yang.
3. Text Book of Remote Sensing and Geographical Information Systems by M. Anji Reddy.
4. Precision Agriculture Technologies for Food Security and Sustainability By A El-Kader, M Sherine, M El-Basioni and M Basma.
5. Principles and Theory of Geoinformatics by P.K. Garg. Khanna Publishers. 296p
6. Advances in Geoinformatics Remote Sensing and GIS by Bhunia, Gouri Sankar, Uday Chatterjee and Gopal Krishna Panda. BIO GREEN
7. Artificial Intelligence: Machine Learning, Deep Learning, and Automation Processes by John Adamssen. Efalon Acies.
8. Remote Sensing and Image Interpretation, 6th edn (WSE) Paperback – 1 January 2011, Willey Student Edition.
9. Remote Sensing and Geographic Information by A.M. Chandra and S.K. Ghosh. Narosa.

Course No.	:	AGR 404
Course Title	:	Principles and Practices of Organic Farming / Conservation Agriculture
Credit Hours	:	3+1
Course category	:	Elective course

Course learning Rationale/ Course Objectives (CLR):

1. To teach students the principles of crop production under organic and conservation agriculture situation
2. To impart practical knowledge of organic and conservation agriculture practices

Course Learning Outcome (CLO):

1. Understanding the principles of crop production under organic and conservation agriculture situation
2. Acquiring skill in waste recycling and preparation of inputs for organic cultivation
3. Acquiring skill in organic and conservation agriculture practices
4. Gaining knowledge on organic certification procedures and marketing of organic produce

THEORY

Unit 1: Concept of Organic farming

Organic farming – definition, concept, characteristics and limitations; Ill effects of green revolution technology; Global and Indian Scenario of organic farming; Principles, history and its scope in India; Biodiversity – Types, importance and its conservation; Different forms of organic farming; Biodynamic farming and Zero budget natural farming;

Unit 2: Organic management practices

Selection of land and steps in conversion of land for organic farming; Choice of crops and varieties in organic farming; Nutrient management in organic farming and their sources; Organic manures- recommended doses and application in comparison to inorganic fertilizers for major crops; Fundamentals of insect pest, disease and weed management under organic mode of production; Integrated farming systems in different ecosystems;

Unit 3: Organic farming Certification

Operational structure; Certification process and crop standards of organic farming, Processing, labelling of NPOP, PGS-India

Unit 4: Marketing and initiatives for promotion of Organic farming

Economic considerations and viability, marketing and export potential of organic products. Organic livestock production and bee keeping; Initiatives taken by Government (central/state), NGOs and other organizations for promotion of organic agriculture.

Unit 5: Conservation agriculture

Conservation agriculture: definition, origin, principles, advantages, challenges; Primary practices in conservation agriculture: minimum soil disturbance, crop residue retention, and crop diversification, complementary practices, conservation agriculture vis a vis Climate Smart Agriculture.

Theory - Lecture Schedule

1. Organic farming – definition, concept, characteristics and limitations and Ill effects of green revolution technology
2. History of organic farming
3. Global and Indian Scenario of organic farming
4. Principles of organic farming
5. Scope of organic farming in India;
6. Biodiversity – Types, importance and its conservation
7. Different forms of organic farming
8. Biodynamic farming and Zero budget natural farming
9. Selection of land and steps in conversion of land for organic farming
10. Choice of crops and varieties in organic farming
11. Selection of crops and cropping systems in relation to maintenance of soil

productivity

12. Nutrient management in organic farming and their sources
13. Organic manures - Introduction and classification.
14. Organic manures - recommended doses and application in comparison to inorganic fertilizers for major crops.
15. Aerobic and Anaerobic composting
16. Soil biota and efficient microorganisms
17. Earth worms and vermicomposting
18. Biofertilizers – Classification, forms and its application
19. Biogas technology – Scope, types, merits and demerits
20. Organic farming and water use efficiency
21. Fundamentals of insect pest management under organic mode of production
22. Fundamentals of disease management under organic mode of production
23. Fundamentals of weed management under organic mode of production
24. Harvesting and Post harvest management of organic produce

25. Mid Semester Examination

26. Organic livestock production and bee keeping
27. Organic bee keeping
28. Integrated farming systems in different ecosystems
29. Operational structure of NPOP
30. NPOP Certification process
31. NPOP crop standards of organic farming
32. Processing and handling of organic products
33. Labelling and quality standards of organic products
34. Guiding principles of PGS-India
35. Operational structure of PGS-India
36. Certification process of PGS-India
37. Grant of logo and labelling of PGS-India
38. Economic considerations and viability of organic products
39. Marketing and Export potential of organic products.
40. Initiatives taken by Government (central/state), NGOs and other organizations for promotion of organic agriculture.
41. Conservation agriculture: definition, origin
42. Principles, advantages and challenges of conservation agriculture
43. Primary practices in conservation agriculture
44. Minimum soil disturbance in conservation agriculture
45. Crop residue retention in conservation agriculture
46. Crop diversification in conservation agriculture
47. Complementary practices of conservation agriculture
48. Conservation agriculture vis a vis Climate Smart Agriculture

Practical

Visit of organic farms to study the various components and their utilization; Preparation of enrich compost, vermicompost and their quality analysis; Method of application of bio-fertilizers; Indigenous technology knowledge (ITK) for nutrient, insect-pest and disease management; Studies in green manuring in-situ and green leaf manuring, Studies on different type of botanicals for insect- pest management; Weed management in organic farming; Cost of organic production system; Practices of conservation agriculture.

Practical Schedule

1. Visit of organic farms to study the various components and their utilization;
2. Preparation of enrich compost
3. Preparation of vermicompost
4. Quality analysis of compost
5. Acquiring skill in method of application of bio-fertilizers
6. Acquiring skill in Indigenous technology knowledge (ITK) for nutrient management
7. Acquiring skill in Indigenous technology knowledge (ITK) for insect-pest management
8. Acquiring skill in Indigenous technology knowledge (ITK) for disease management
9. Practicing green manuring in-situ and green leaf manuring
10. Acquiring skill in different type of botanicals for insect- pest management
11. Acquiring skill in weed management in organic farming
12. Acquiring skill in harvesting and post-harvest management in organic farming
13. Work out the cost of organic production system
14. Acquiring skill in minimum soil disturbance
15. Acquiring skill in crop residue retention
16. Acquiring skill in crop diversification
- 17. Final Practical Examination**

Suggested Readings:

1. Acharya Sankar Kr, Sreemoyee Bera, Cornea Saha, Prabhat Kumar, Monirul Haque, Riti Chatterjee and Anwesha Mandal. 2022. Conservation Agriculture Approach and Application. Scholars World. 292p.
2. Arun. K. Sharma. Handbook of Organic Farming. Agrobios (India), Jodhpur.
3. Dahama, A.K. Organic Farming for Sustainable Agriculture. Agrobios (India), Jodhpur.
4. Gaur, A.C. Handbook of Organic farming and biofertilizers.
5. Palaniappan, S.P., and K. Annadurai. Organic Farming – Theory and Practice. Scientific Publishers. Jodhpur.
6. Purshit, S.S. Trends in Organic Farming in India. AgrosBios (India), Jodhpur.
7. Sathe, T.V. Vermiculture and Organic Farming. Days Publishing House, New Delhi.

8. Singh, Abhinandan, Pankaj Kumar Ojha and Rahul Kumar, 2018. Conservation Agriculture Technologies. Biotech Books.
9. Thampan, P.K. Organic Agriculture. Peckay tree Crops Development Foundation, Cochin, Kerala.
10. Thapa, U. and P. Tripathy. Organic Farming in India- Problems and Prospects. Agrotech publishing agency, Udaipur.
11. Veeresh, G.K. Organic Farming. Foundation Books. New Delhi.

Course No.	:	GPB 401
Course Title	:	Commercial Plant Breeding
Credit Hours	:	3+1
Course Category	:	Elective course

Course Learning Rationale / Course Objective (CLR):

1. To provide in-depth knowledge on hybrid development and crop improvement strategies for major field crops such as rice, wheat, maize, pearl millet, sorghum, pigeon pea, chickpea, green gram, black gram, lentil, soybean, groundnut, rapeseed-mustard, and cotton.
2. To develop a conceptual and practical understanding of tissue culture and biotechnological tools as alternative strategies for the development of inbred lines and cultivars.
3. To impart comprehensive knowledge on seed production techniques, procedures for variety release and notification, and the legal framework under the Protection of Plant Varieties and Farmers' Rights (PPV&FR) Act, 2001.

Course Learning Outcomes (CLO):

1. Understand the classification of crops and modes of plant reproduction and apply knowledge of floral biology, selfing, and crossing techniques for developing hybrid seeds in self- and cross-pollinated crops.
2. Demonstrate competency in line development and maintenance breeding techniques, including A/B/R and two-line systems, and apply genetic tests for evaluating commercial hybrid seed purity.
3. Gain practical skills in hybrid seed production techniques across major field and vegetable crops, including the use of male sterility, pollinator management, rouging, and seed processing methods like drying, grading, and packaging.
4. Utilize advanced tools and strategies such as speed breeding, breeding management systems, high-throughput phenotyping/genotyping platforms, and biotechnological methods (e.g., haploid induction and tissue culture) for efficient cultivar development.

5. Interpret and apply the legal and regulatory frameworks in commercial plant breeding, including DUS testing, PPV&FR Act compliance, and procedures for variety testing, release, and notification in India.

THEORY

Unit 1: Crop Classification and Plant Reproduction

Types of crops and Modes of plant reproduction: sexual and asexual reproduction. Floral biology of self- and cross-pollinated crops. Significance of pollination types in crop breeding.

Unit 2: Line Development, Hybrid Breeding Systems, and Genetic Purity

Line development and maintenance breeding in self-pollinated crops and cross-pollinated crops A/B/R (three-line system) and two-line system in hybrid development. Genetic Purity test of commercial hybrids. Principles and techniques of seed production. Types of seeds: Nucleus, Breeder, Foundation, Certified, TL seeds. Quality testing of seeds in self- and cross-pollinated crops.

Unit 3: Hybrid Seed Production in Field and Vegetable Crops

Advances in hybrid seed production techniques. Hybrid seed production in Maize, Rice, Sorghum, Pearl millet, Castor, Sunflower, Cotton, Pigeon pea, Brassica. Quality seed production of vegetable crops under open and protected environments.

Unit 4: Modern Tools and Techniques in Breeding

Speed breeding and rapid generation advancement, Breeding Management Systems (BMS), High-throughput phenotyping platforms, High-throughput genotyping platforms, Alternative strategies for the development of line cultivars: Haploid inducer techniques, Tissue culture methods, Biotechnological tools in breeding.

Unit 5: Legal and Regulatory Aspects of Plant Breeding

IPR issues in commercial plant breeding. DUS (Distinctness, Uniformity, Stability) testing. Registration of varieties under the PPV&FR Act. Variety testing systems; Variety release and notification procedures in India. Commercial seed chain and seed value addition; Role of private and public sectors in hybrid seed production. Current trends, and future prospects in hybrid seed technology.

Theory – Lecture 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 and their classification
10. Seed quality testing in self- and cross-pollinated crops
11. Advances in hybrid seed production techniques
12. Hybrid seed production in rice
13. Hybrid seed production in maize
14. Hybrid seed production in sorghum
15. Hybrid seed production in pearl millet
16. Hybrid seed production in castor
17. Hybrid seed production in sunflower
18. Hybrid seed production in cotton
19. Hybrid seed production in pigeon pea
20. Hybrid seed production in Brassica
21. Hybrid seed production in tomato
22. Hybrid seed production in brinjal
23. Hybrid seed production in bhendi
24. Hybrid seed production in capsicum

25. Mid Semester Examination

26. Hybrid seed production in chilli
27. Hybrid seed production in cucurbits, cabbage, and cauliflower
28. Quality seed production of vegetable crops under open and protected environments
29. Alternative strategies for line and cultivar development: Haploid inducer techniques
30. Alternative strategies for line and cultivar development: Tissue culture techniques
31. Alternative strategies for line and cultivar development: Genetic engineering and biotechnological tools
32. Speed breeding and rapid generation advancement
33. Breeding Management Systems (BMS) : Overview and application
34. High-throughput phenotyping platforms in plant breeding
35. High-throughput genotyping platforms in plant breeding
36. Molecular markers and their application in hybrid breeding
37. Genomic selection in modern plant breeding
38. Speed breeding and rapid generation advancement
39. Marker-assisted selection (MAS) and its integration with hybrid breeding
40. Overview of biotechnology tools used in hybrid breeding
41. IPR issues in commercial plant breeding
42. DUS testing and its importance
43. Registration of varieties under PPV & FR Act
44. Variety testing and evaluation systems in India
45. Variety release and notification procedures in India
46. Variety replacement rate and its significance

47. Commercial seed chain and seed value addition; Role of private and public sectors in hybrid seed production
48. Current trends, and future prospects in hybrid seed technology

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.

Practical Schedule

1. Study of floral biology in self- and cross-pollinated species; demonstration of selfing and crossing techniques
2. Techniques of seed production in self- and cross-pollinated crops using A/B/R (three-line) and two-line systems
3. Demonstration of male-sterility-based hybrid seed production in field crops
4. Observation and analysis of difficulties and challenges in hybrid seed production
5. Study of tools and techniques used to optimize hybrid seed production efficiency
6. Understanding the concept of rouging, line identification, and multiplication/purification of parental lines in hybrid seed production
7. Observation of the role of pollinators and their management in hybrid seed production plots
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, capsicum)
13. Sampling and analytical methods for genetic purity testing and detection of spurious seed
14. Study of seed drying techniques and storage structures in quality seed management
15. Demonstration of screening techniques during seed processing – grading and packaging

16. Visit to public and private hybrid seed production fields and seed processing plants

17. Final Practical Examination

Suggested Readings:

1. Commercial Plant Breeding at a glance by Phundan Singh, Pratibha Bisen, Reshu Tiwari. Daya Publishing House.
2. Plant Breeding: Principles and Methods by B. D. Singh. Kalyani Publishers.
3. Principles of Plant Breeding (1st & 2nd Edition) by R.W. Allard.
4. Breeding Field Crops by J.M. Poehlman.
5. Commercial Plant Breeding Objective: Phundan Singh, Mridula Billore and Monika Singh.
6. Astral Publishing, 160p.
7. Breeding and Crop Production: H. Padmalatha, Random.
8. Biotechnology for Agricultural Breeding: Mangal, S. K. GeneTech Books.

Course No.	:	GPB 402
Course Title	:	Biotechnology for Crop Improvement
Credit Hours	:	3+1
Course Category	:	Elective Course

Course Learning Rationale / Course Objective (CLR):

The purpose of learning this course is to:

1. Understand the fundamental principles and techniques of plant tissue culture and their application in crop improvement.
2. Introduce molecular biology tools including DNA markers, vector systems, and gene mapping for trait identification and breeding.
3. Explore methods for genetic transformation and the development of transgenic crops.
4. Familiarize students with the regulatory, ethical, and safety aspects of GMOs and biotechnology products in agriculture.
5. Equip students with basic bioinformatics and nanotechnology tools applicable to plant breeding and molecular genetics.

Course Learning Outcomes (CLO):

1. Explain key concepts and methodologies in plant tissue culture and their utility in crop improvement programs.

2. Demonstrate proficiency in basic molecular techniques such as DNA isolation, PCR, marker analysis, and transformation protocols.
3. Analyze molecular marker data for trait mapping and apply marker-assisted selection for crop breeding.
4. Evaluate the biosafety, ethical, and legal considerations in the use of genetically modified crops and biotechnology products.
5. Apply bioinformatics tools and nanotechnology concepts to solve crop improvement challenges and support breeding strategies.

THEORY

Unit 1: Introduction to Agricultural Biotechnology and Tissue culture

Biotechnology and its relevance in agriculture; Definitions, terminologies and scope in plant breeding. Tissue culture- History, callus, suspension cultures, cloning; Regeneration; Somatic embryogenesis; Anther culture; somatic hybridization techniques; Meristem, ovary and embryo culture; cryopreservation.

Unit 2: Molecular Techniques and Marker Systems

Techniques of DNA isolation, quantification and analysis; Genotyping; Sequencing techniques; Vectors, vector preparation and cloning, Biochemical and Molecular markers: morphological, biochemical and DNA-based markers (RFLP, RAPD, AFLP, SSR, SNPs, ESTs etc.), mapping populations (F₂s, back crosses, RILs, NILs and DH). Molecular mapping and tagging of agronomically important traits. Statistical tools in marker analysis, Robotics;.

Unit 3: Molecular Assisted Breeding and Genomic applications

Marker-assisted selection for qualitative and quantitative traits; QTLs analysis in crop plants, Gene pyramiding Marker assisted selection and molecular breeding; Genomics and genoinformatics for crop improvement; Integrating functional genomics information on agronomically / economically important traits in plant breeding; Marker-assisted backcross breeding for rapid introgression, Generation of EDVs.

Unit 4: Genetic Engineering and Transgenic Crop Development

Recombinant DNA technology, transgenes, method of transformation, selectable markers and clean transformation techniques, vector-mediated gene transfer, physical methods of gene transfer. Production of transgenic plants in various field crops: cotton, wheat, maize, rice, soybean, oilseeds, sugarcane etc. Commercial releases.

Unit 5: Regulatory Framework, Bioethics and Emerging Technologies

Biotechnology applications in male sterility/hybrid breeding, molecular farming. MOs and related issues (risk and regulations); GMO; International regulations, biosafety issues of GMOs; Regulatory procedures in major countries including India, ethical, legal and social issues; Intellectual property rights, Bioinformatics & Bioinformatics tools. Nanotechnology and its applications in crop improvement programmes.

Theory - Lecture Schedule

1. Biotechnology: Definition, scope, and relevance in agriculture
2. Important terminologies in plant biotechnology
3. History and development of tissue culture
4. Callus and suspension culture techniques
5. Cloning and regeneration pathways
6. Somatic embryogenesis – principles and applications
7. Anther and microspore culture techniques
8. Somatic hybridization and protoplast fusion
9. Meristem culture and virus-free plants
10. Ovary and embryo culture techniques
11. Cryopreservation and its applications
12. Applications of tissue culture in plant breeding
13. DNA isolation techniques
14. DNA quantification and quality assessment
15. Electrophoresis and analysis methods
16. DNA sequencing techniques – Sanger, NGS basics
17. Vectors and cloning: types and preparation
18. Morphological and biochemical markers
19. DNA-based markers: RFLP, RAPD, AFLP
20. SSRs, SNPs, ESTs – applications in crop plants
21. Mapping populations: F₂s, BCs, RILs, NILs, DHs
22. Molecular mapping of traits
23. Marker-assisted selection (MAS) – principles Statistical tools and software for marker analysis
24. Robotics in molecular breeding
25. **Mid Semester Examination**
26. QTL mapping and gene pyramiding strategies
27. Introduction to recombinant DNA technology
28. Transgene development and selectable markers
29. Transformation methods: Agrobacterium-mediated
30. Physical methods of gene transfer
31. Clean transformation and gene editing
32. Development of GM crops: rice, maize, cotton, etc.
33. Marker-assisted backcross breeding (MABB)
34. EDVs (Essentially Derived Varieties)
35. Functional genomics in trait analysis
36. Genoinformatics for crop improvement
37. Molecular breeding strategies: overview
38. Commercial releases of transgenic crops
39. Male sterility systems and hybrid breeding

40. Molecular farming and biopharming
41. GMOs and global regulatory frameworks
42. Indian biosafety guidelines and GEAC
43. Ethical, legal, and social implications of GMOs
44. IPRs in agricultural biotechnology
45. Introduction to bioinformatics
46. Bioinformatics tools for gene identification
47. Nanotechnology in agriculture: concepts
48. Nanotechnology in agriculture: Applications

Practical

Requirements for plant tissue culture laboratory-Techniques in plant tissue culture – Media components and media preparation -Aseptic manipulation of various explants; observations on the contaminants occurring in media – interpretations - Inoculation of explants; Callus induction and plant regeneration - Plant regeneration; Standardizing the protocols for regeneration; Hardening of regenerated plants; Establishing a greenhouse and hardening procedures - Visit to commercial micropropagation unit. Transformation using *Agrobacterium* strains, GUS assay in transformed cells / tissues. DNA isolation, DNA purity and quantification tests, gel electrophoresis of proteins and isozymes, PCR-based DNA markers, gel scoring and data analysis for tagging and phylogenetic relationship, construction of genetic linkage maps using computer software.

Practical Schedule

1. Orientation: Lab setup and safety protocols
2. Media preparation and composition
3. Aseptic techniques and inoculation of explants
4. Callus induction and regeneration
5. Protocol standardization and hardening
6. Visit to commercial micropropagation unit
7. DNA extraction from plant tissues
8. Quantification and purity assessment (spectrophotometry)
9. Gel electrophoresis and band visualization
10. *Agrobacterium*-mediated transformation
11. GUS assay in transformed tissues
12. PCR-based DNA marker amplification
13. Scoring of DNA bands, polymorphism analysis
14. Construction of phylogenetic tree using marker data
15. Construction of genetic linkage maps using software (e.g., MAPMAKER)
16. Basics of bioinformatics: NCBI, BLAST, and gene annotation tools
- 17. Final Practical Examination**

Suggested Readings:

1. Chopra V. L, & Nasim A. 1990. Genetic Engineering and Biotechnology: Concepts, Methods and Applications. Oxford & IBH.
2. Gupta P. K. 1997. Elements of Biotechnology. Rastogi Publ.
3. Hackett P. B., Fuchs J. A. & Messing J. W. 1988. An Introduction to Recombinant DNA Technology - Basic Experiments in Gene Manipulation. 2nd Ed. Benjamin Publ. Co.
4. Sambrook J & Russel D. 2001. Molecular Cloning - a Laboratory Manual. 3rd Ed. Cold Spring Harbor Lab. Press.
5. Singh B. D. 2005. Biotechnology, Expanding Horizons. Kalyani.

Course No.	:	GPB 403
Course Title	:	Micro-propagation Technologies
Credit Hours	:	3+1
Course Category	:	Elective Category

Course Learning Rationale/Course Objective (CLR):

The purpose of learning this course is to:

1. Understand the stages of micropropagation: initiation, multiplication, rooting, acclimatization.
2. Study protocols for micropropagation of medicinal, ornamental, and horticultural crops.
3. Understand media components and plant hormones used in tissue culture.
4. Acquire entrepreneurship skills in setting up plant biotechnology ventures
5. Develop skills to design and establish a commercial tissue culture lab.

Course Learning Outcomes (CLO):

1. Explain in vitro culture and micropropagation for plantlet production
2. Analyze media, hormones, and nutrients used in tissue culture
3. Describe haploid culture techniques for plant breeding and genetic advancement
4. Explain organizational roles, certification standards, and quality control processes
5. Outline key requirements for commercial tissue culture lab establishment

THEORY

Unit 1: Introduction to Micropropagation and Laboratory Setup

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 2: Media Preparation and Plant Regeneration

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. Organogenesis-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 3: Different types of Tissue Culture techniques and its applications

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 4: Micropropagation techniques in commercially important crops

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 5: Hardening, Certification and Commercialization

Primary hardening of tissue cultured plants – requirements and layout of polyhouse. Secondary hardening of Tissue cultured plant - 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.

Theory - Lecture Schedule

1. Meaning and concept of *in vitro* culture, micropropagation, totipotency, dedifferentiation
2. Different concepts employed in tissue culture.
3. Scope and role of Plant Tissue culture in crop improvement.
4. Historical mile stones, advancement and future prospects of micropropagation
5. Different tissue culture techniques- applications, advantages and limitations.
6. Layout of Tissue culture, requirements and types- small, medium and large-scale laboratories.
7. Environmental requirements of Tissue culture unit.
8. Techniques of sterilization/asepsis for glass and metal ware,
9. Techniques of sterilization/asepsis liquids both thermo stable and thermo labile, disposal of remnants of culture.
10. Components of the tissue culture media – Inorganic nutrients, vitamins, amino acids and other organic supplements.
11. Components of the tissue culture media- carbon source, hormones/ plant growth regulators, pH of the media, gelling agents.
12. Preparation of media – Stocks and working media, preparation and storage.
13. Genetic control of regeneration. Pathways of regeneration of plants and Regeneration methods- morphogenesis, organogenesis and embryogenesis.
14. Organogenesis-Purpose, methods and requirements for organogenesis, indirect and direct organogenesis.
15. Somatic embryogenesis and factors affecting somatic embryogenesis - Differences between gametic and somatic embryos.
16. Culture types - callus culture and cell suspension culture - applications and limitations
17. Shoot tip and meristem tip culture - applications and limitations
18. Auxillary bud proliferation - application and limitations.
19. Anther culture, pollen culture and ovary culture- applications and limitations.
20. Pollen culture and ovary culture- applications and limitations
21. Ovary culture- applications and limitations
22. Production of virus free plants through Meristem tip culture.
23. Synthetic seeds and Artificial seed – Concept, necessity, procedure and requirements of synthetic seeds.
24. Micropropagation-Definition, stages of micropropagation – factors affecting micropropagation – application and limitations.
- 25. Mid Semester Examination**
26. Micropropagation techniques in Banana
27. Micropropagation techniques in Sugarcane
28. Micropropagation techniques in Bamboo
29. Micropropagation techniques in Cassuarina
30. Micropropagation techniques in Neem and Eucalyptus

31. Micropropagation techniques in Aloe vera and Phyllanthus
32. Micropropagation techniques in Gerbera and Coleus
33. Micropropagation techniques in Rose and Chrysanthemum
34. Micropropagation techniques in Orchids
35. Primary hardening of tissue cultured plants –requirements and layout of polyhouse.
36. Secondary hardening of Tissue cultured plants- requirements and layout of shade net provision.
37. Cryopreservation and Germplasm Storage Techniques
38. In Vitro Conservation of Rare, Endangered and Medicinal Plants
39. National certification and Quality management of TC plants
40. Genetic fidelity test and virus indexing in TC plants.
41. Production of secondary metabolites through cell culture techniques.
42. Role of Nanotechnology in Plant Tissue Culture
43. Bioinformatics Tools in Plant Tissue Culture Research
44. Public and private organizations involved in Plant Tissue culture in India.
45. Preparation of Project proposal for establishing a commercial Tissue culture lab.
46. Intellectual Property Rights (IPR) in Plant Tissue Culture
47. Entrepreneurship Development in Tissue Culture
48. Case Studies of Successful Commercial TC Labs in India and Abroad

Practical

Laboratory organization, Laboratory organization small, medium and large-scale laboratories. Sterilization techniques for explants, glassware, plasticwares, labware's 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.

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**

Suggested Readings:

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.
5. Bhojwani, S.S. and Dantu, P.K. 2013. Plant Tissue Culture: An Introductory Text. Springer, India, New Delhi.

Course No	:	HOR 401
Course Title	:	Hi-tech Horticulture
Credit Hours	:	3+1
Course Category	:	Elective Course

Course Learning Rationale / Course Objective (CLR):

1. Understand the basic principles and significance of Hi-tech horticulture.
2. Acquire skills in the selection and utilization of appropriate Horticulture techniques.
3. To educate the students on the latest technology of hi-tech horticulture
4. To educate students on the concepts and prospects of hi-tech horticulture

Course Learning Outcomes (CLO):

1. Learning about advanced technologies developed for protected cultivation/hi-tech Practices.
2. Know the micropropagation and tissue culture, learning about the components of Hi-Tech horticulture and micro-irrigation system.
3. Know the application of precision farming elements in horticultural crops.

THEORY**Unit 1: Introduction to Hi Tech Horticulture**

Introduction and importance; Nursery management and mechanization; micro propagation of horticultural crops; Modern field preparation and planting methods.

Unit 2: Protected cultivation, types and its importance

Protected cultivation: advantages, controlled conditions, method and techniques; Micro irrigation systems and its components.

Unit 3: Site Specific Management practices and Precision Farming

EC, pH based fertilizer scheduling; canopy management; high density orcharding; Components of precision farming.

Unit 4: Remote Sensing

Remote sensing; Geographical Information System (GIS); Differential Geo-positioning System (DGPS); Variable Rate Applicator (VRA).

Unit 5: Application of Precision farming Techniques in Crops

Application of precision farming in horticultural crops (fruits, vegetables and ornamental crops); mechanized harvesting of produce.

Theory – Lecture Schedule

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
4. Mechanisation of nursery, sowing and transplanting, plastic mulching, irrigation, fertigation, pest and disease control, weed control, harvesting etc.
5. Micro propagation of horticultural crops – Meristem culture - Various approaches of shoot multiplication
6. Applications of micro propagation – Problems in micropropagation - Advantages and limitations – Micro-grafting.
7. Modern field preparation methods – Raised bed preparation – Plastic mulching.

8. Modern planting methods – Container planting - Soil less culture – Hydroponics, aeroponics.
9. Protected cultivation- Advantages- Scope and Importance
- 10 & 11. Types of protected structures - Glass house, poly house, rain shelters, poly tunnels, hotbeds and cold frames, shade nets etc.
- 12 & 13. Greenhouse – Advantages- Controlled conditions – Light, Humidity, Temperature, CO₂ - Ventilation and cooling in a green house – Naturally ventilated, fan and pad cooling, forced air cooling etc. – Relative humidity, carbon-di-oxide level.
- 14 & 15. 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.
16. Fertigation – Advantages –Limitations - Method of fertilizer injection (Fertilizer injection system, Pressure differential injection system, Venturi injection system) – Selection of fertilizers – Solid fertilizers & liquid fertilizers.
17. EC, pH based fertilizer scheduling – Site specific nutrient management – Advantages and disadvantages.
18. Introduction to Canopy management in Horticultural Crops
19. Importance of canopy management- principles of canopy management – Tools of canopy management (Rootstocks, plant density, training and pruning, nutrient management, growth retardants etc.).
- 20 & 21. High Density orcharding – Concept of HDP systems. Impact of HDP- Advantages- Constraints in HDP.
- 22 & 23. 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.)
24. Precision farming – Definition – Scope and status of precision farming in India
- 25. Mid Semester Examination**
- 26 & 27. Perspectives and potentials of precision farming in India & Components of precision farming.
- 28 & 29. Remote sensing – Role of remote sensing in precision farming - Application of remote sensing in the field of horticulture.
- 30 & 31. Geographical Information System (GIS) – Role of GIS in precision farming.
- 32 & 33. 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.).
34. Variable Rate applicator (VRA) – Introduction – Variable rate application methods
- 35 & 36. Map based VRA and Sensor based VRA – VRA management zones – Seeding VRA, Weed control VRA, Lime VRA, Fertilizer VRA.
- 37, 38 & Precision farming – Applications of precision farming in Vegetable crops

- 40, 41 & 42. Strategic approaches of precision technology for improvement of fruit production.
- 43 & 44. Strategic approaches of precision technology for improvement of Flower crops.
- 45 & 46. Mechanized harvesting of produce – Advantages and disadvantages of mechanical harvesting – Mechanical harvesters developed for different horticultural crops – Robots in harvesting.
47. Green food production – Approaches – Biodynamic farming – Biodynamic preparations – Cosmic integration – Biodynamic calendar – Strategies for green food production

Practical

Types of polyhouses and shade net houses, Intercultural operations, tools and equipment identification and application, Micro propagation, Nursery- portrays, micro-irrigation, EC, pH based fertilizer scheduling, canopy management, visit to hi-tech orchard/nursery.

Practical Schedule

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**

Suggested Readings:

1. Prasad, S. And Kumar, U. 2012. *Greenhouse Management of Horticultural Crops*. 2nd 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.

Course No.	:	PAT 401
Course Title	:	Plant Disease Detection, Diagnosis and Management
Credit Hours	:	3+1
Course Category	:	Elective Course

Course Learning Rationale / Course Objective (CLR):

1. To understand detection and diagnosis of plant disease
2. To acquaint with various principles of plant disease management
3. To comprehend the biotechnological approaches and IDM modules

Course Learning Outcomes (CLO):

1. Acquaint the epidemiology, biological, chemodiagnosis, serodiagnosis and molecular diagnosis of plant diseases
2. Understand plant disease quarantine, cultural, mechanical, physical, chemical and biological methods of plant disease management
3. Comprehend with application of tissue culture and genetic engineering in developing disease free plants

THEORY

Unit 1: Epidemiology and Diagnosis of Plant Diseases

Introduction to plant diseases - Epidemiology of plant diseases- role of weather factors in disease development - Disease surveillance, assessment and forecasting– Remote sensing techniques and image analysis - AI tools - Diagnosis of plant diseases- Detection of seed borne pathogen- chemodiagnosis, serodiagnosis (ELISA, Direct ELISA, Indirect ELISA, DAC- ELISA, DAS-ELISA and TAS-ELISA) and Molecular diagnosis (Nucleic acid-based detection methods: PCR, RT-PCR, qRT-PCR Genetic markers; Protein based detection method: SDS PAGE, Western blotting, MALDI -TOF; Metabolomics: Chromatographic Techniques)

Unit 2: Principles - Avoidance & Exclusion

Avoidance- Role of cultural practices in plant disease management. Exclusion- Plant quarantine – domestic, International and Embargo - Phytosanitary certificate- Quarantine in India- Post Entry Quarantine- Exotic diseases introduced into India- Pest risk analysis.

Unit 3: Eradication

Eradication of pathogens from seed and Planting materials – Eradication of diseased plants- Surgery and Rouging – Eradication of Alternate and Collateral host- different methods of eradication- Mechanical, physical, chemical and biological methods.

Unit 4: Protection

Protection of crops from air borne, seed borne, soil borne and vector borne plant diseases-Physical methods- soil solarization, Hot water treatment, Incineration. Chemical control of plant diseases- Fungicides- Ideal characters – History and development of fungicides- Fungicide formulation and auxillary spray material- Classification of fungicide – Mode of action – FRAC- Contact Fungicides – Systemic Fungicides- Different types of Formulation- Composite Formulation- Methods of application and special methods of application - Compatibility and Phytotoxicity of fungicides – Fungicide resistance -Assessing cost-benefit ratio- Factors affecting fungicides- Antibiotics in plant disease management- Biological control of plant diseases – Plant products, Plant activators and Antiviral principles- method of application- plant protection appliances.

Unit 5: Immunization, Biotechnological approaches and integrated Disease management (IDM) module

Immunization - cross protection and host plant resistance – Types of resistance - vertical and horizontal resistance – resistance breeding and resistant varieties. Mechanism of resistance- structural and bio chemical resistance in plants - Biotechnological approaches for crop disease management. Implementation and impact of IDM. IDM module for Soil borne, air borne, Seed borne and vector borne plant disease management- IDM module for rice, groundnut, cotton, sugarcane, brinjal, bhendi, coconut and banana

Theory – Lecture Schedule

1. Introduction to diseases - disease triangle/ disease Pyramid
2. Epidemiology- Role of weather factors in plant disease development, Boom and bust cycle in disease outbreak
3. Plant disease surveillance and assessment
4. Plant disease forecasting
5. Remote sensing techniques and image analysis, AI tools (Apps in disease diagnostic)
6. Detection of seed borne pathogens
7. Diagnostic techniques for detecting crop pathogens -Biological method and Chemodiagnosis
8. Diagnostic techniques for detecting crop pathogens – Serodiagnosis (ELISA, Direct ELISA, Indirect ELISA, DAC- ELISA, DAS-ELISA and TAS-ELISA)
9. Molecular detection and diagnosis of diseases
10. Nucleic acid-based detection methods: PCR, RT-PCR, qRT-PCR Genetic markers
11. Protein based detection method: SDS PAGE, Western blotting
12. Metabolomics: GCMS, LCMS, MALDI -TOF

13. Principles of crop disease management - Avoidance and Exclusion- plant quarantine – domestic, international and embargo - phytosanitary certificate- Quarantine in India. Post entry quarantine in India. Exotic diseases introduced into India
14. Principles of crop disease management - Eradication - Different methods of eradication of plant diseases
15. Principles of crop disease management - Protection – Physical and chemical methods of protection
16. Fungicides – Ideal characters – History and development of fungicides
17. Fungicide formulations and auxiliary spray material.
18. Composite formulations of fungicides – Fungicide resistance
19. Registration of fungicides under CIBRC – Acts and norms
20. Classification of fungicide – Mode of action - FRAC
21. Contact Fungicides – Sulphur fungicides, copper fungicides, Mercury fungicides, Heterocyclic nitrogen compounds, Organo tin, Quinone, Benzene and Miscellaneous compounds - classification and uses
22. Systemic fungicides – classification and uses
23. New generation fungicides
24. Antibiotics – classification and uses
25. **Mid Semester Examination**
26. Methods of application of fungicides- preparation of spray solution - seed treatment, foliar spray and soil drenching
27. Methods of application of fungicides - Special methods of application and Post harvest treatment of fungicides
28. Plant protection equipment's including drones
29. Compatibility and Phytotoxicity of fungicides
30. Assessing cost-benefit ratio, factors affecting fungicides uses
31. Biological control – Definition – Ideal characters of biocontrol agents - Mechanism of action of biocontrol agents
32. Exotic and native biocontrol agents- Competitive saprophytic ability, virulence and PGPR activity
33. Mass production and methods of application of fungal biocontrol agents
34. Mass production and methods of application of bacterial biocontrol agents
35. Quality control of BCA and norms for registration of biopesticides
36. Botanicals in plant disease management – antiviral principles – preparation – methods of application
37. Principles of crop disease management – Immunization - Host plant resistance- Vertical and horizontal resistance
38. Structural defence in plants – Pre-existing and post inflectional
39. Biochemical defence in plants – Pre-existing and post inflectional – Phytoalexins, PR proteins
40. Biochemical defence in plants – Acquired Resistance (ISR, SAR), Plantibodies and cross protection
41. Cross protection –Definition-production of preimmunized acid lime seedlings

42. Different methods of developing resistant varieties
43. Biotechnological approaches in plant diseases management: Tissue culture techniques- meristem tip culture, monoclonal variation
44. Biotechnological approaches in plant diseases management: Genetic engineering in plant diseases management – Production of transgenic plants
45. Integrated plant disease management (IPDM)
46. IDM measures for soil and seed borne diseases
47. IDM measures for air borne and vector borne diseases
48. IDM module for rice, groundnut, cotton, sugarcane, brinjal, bhendi, coconut and banana

Practical

Survey and Assessment of important plant diseases- Diagnosis of Plant diseases- Classification and grouping of fungicides- Preparation of Bordeaux mixture (1%) and Bordeaux paste (10%), Calculation of fungicides quantity and methods of application of fungicides – Special methods of application. Mass multiplication of *Trichoderma viride*, *Pseudomonas fluorescens* and *Bacillus subtilis* and method of application-Preparation of leaf extracts, oil emulsion of neem and antiviral principles. Cross protection-Tissue culture –meristem tip culture technique. Visit to commercial biocontrol production unit/seed Testing Laboratory and pesticide testing laboratory.

Practical Schedule

1. Survey and assessment of important plant diseases
2. Diagnostic techniques for detecting plant pathogens
3. Seed health test for the detection of seed borne pathogens
4. Serological techniques for detection-ELISA, DIBA
5. Molecular methods of detection- Isolation of DNA and RNA
6. PCR – RT-PCR- Nested PCR
7. Introduction to bioinformatics- BLAST, Phylogeny tree construction
8. Preparation of Bordeaux mixture and Bordeaux paste
9. Calculation of spray fluid and methods of application of fungicides
10. *In vitro* assay of fungicides against fungal pathogens
11. Isolation of the fungal antagonists, its screening and formulation
12. Isolation of the bacterial antagonists, its screening and formulation
13. Preparation of plant extracts and antiviral principles
14. Cross protection: production of pre immunized citrus seedlings against tristeza virus.
15. Tissue culture – Production of virus free plants through meristem tip culture technique.
16. Visit to commercial biocontrol production unit /seed and pesticide testing laboratories
17. **Final Practical Examination**

Suggested Readings:

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.

Course No.	:	PHT 401
Course Title	:	Post-harvest Technology and Value Addition
Credit Hours	:	3+1
Course Category	:	Elective Course

Course Learning Rationale / Course Objective (CLR):

The purposed of learning this course is to:

1. Understand basic knowledge of different pre-harvest and post-harvest factors affecting the postharvest life of fruits and vegetables.
2. Get knowledge on different storage techniques of horticultural crops.
3. Know the processing techniques for the preparation of value-added products.
4. Gain knowledge on different dehydration techniques of horticultural crops.

Course Learning Outcomes (CLO):

1. Provide practical knowledge on different storage methods for fruits and vegetables.
2. Hands on experience on fruits and vegetables processing technology.
3. Provide skill on postharvest loss reduction through processing of fruits and vegetables.
4. Facilitate the students with knowledge about food processing industries and move them towards entrepreneurship.

THEORY

Unit 1: Principles and importance of postharvest technology

Importance of fruits and vegetables, extent and possible causes of postharvest losses; Pre-harvest factors affecting postharvest quality, maturity, ripening and changes occurring during ripening.

Unit 2: Postharvest 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 3: 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 4: Value added products and dehydration techniques

Tomato products- Concepts and Standards; Drying/ Dehydration of fruits and vegetables - Concept and methods, osmotic drying.

Unit 5: Canning technology

Canning - Concepts and Standards, Packaging of products.

Theory - Lecture Schedule

1. Scope, Importance and present scenario of postharvest technology of fruits and vegetables.
2. Chemical, nutritional and bioactive components of fruits, vegetables, and their important in human diet.
3. Factors responsible for postharvest losses.
4. Pre-harvest factors affecting postharvest quality of fruits and vegetables.
5. Physiology and biochemistry in fruits and vegetables
6. Maturity - assessment methods - maturity indices and standards for commercially important fruits and vegetable crops.
7. Physiological and biochemical changes during maturity and ripening.
8. Respiration and ripening and the factors (external and internal) affecting the ripening of fruits and vegetables.
9. Role of ethylene in ripening of fruits and vegetables
10. Preharvest operations to extend shelf life of fruits and vegetable crops.
11. Post-harvest pest and diseases management in fruits and vegetables
12. Physiological disorders associated with storage - Heat, chilling and freezing injury.
13. Harvesting of fruits and vegetables - Methods - merits and demerits.

14. Postharvest handling of the produce (pre-cooling, sorting, grading and washing).
15. Pre-cooling - methods - advantages and disadvantages.
16. Postharvest disinfestation in fruits and vegetables - methods of application - merits and demerits.
17. Wax coating of and fruits vegetables - types of waxing - application methods - advantages and disadvantages
18. Storage - Methods of storage - Traditional storages (In-situ, pit storage, high altitude, clamp storage, wind breaks, cellars, barns, Night ventilation, Evaporative cool storage ZECC).
19. Improved storage methods (Refrigerated storage, modified atmospheric storage, controlled atmospheric storage, hypobaric storage).
20. Unit operations in packing house of fruits and vegetables - importance - advantages and disadvantages.
21. Packaging of products - Definition - Properties of good packaging materials – different types of packaging materials for fruits and vegetables.
22. Cushioning materials - Purpose - Characteristics of cushioning material during transporting of fruits and vegetables.
23. Traditional packaging methods for fruits and vegetables - advantages and disadvantages.
24. Modern packaging methods (Recent advances) for fruits and vegetables - advantages and disadvantages.
25. **Mid Semester Examinations**
26. Value addition - concept - scope, importance and status of fruit preservation in India.
27. History of food preservation - principles - methods of preservation.
28. Preservation by high temperature - pasteurization, sterilization, blanching, canning, aseptic canning and bottling.
29. Preservation of food by low temperature - principles - methods - merits and demerits.
30. Preservation of food by sugar & salt - principles - methods - merits and demerits
31. Preservation of food by chemicals - concept - standards - application - merits and demerits.
32. Preservation of food by antibiotics - concept - application - merits and demerits.
33. Preservation of food by ionizing radiation - principles - application - advantages and disadvantages.
34. Preservation of food by acid and filtration - concept - application - advantages and disadvantages.
35. Preservation of food by fermentation and carbonation - concept - application - advantages and disadvantages.
36. Intermediate moisture foods - Jam, jelly, marmalade - Problems in Jam making important considerations and problems in Jelly making- Problems in marmalade making.

37. Preserve and candy - Concepts and Standards - Flow chart for manufacturing of preserve and candy - Problems in preservation of preserve and candied fruits.
38. Crystallized and Glazed fruits/vegetables - Concepts and Standards - Flow chart for manufacturing of preserve and candy.
39. Fermented beverage (Wine, Champagne, Port, Sherry, Tokay, Muscat, Perry, Nira, Feni, Cider) - processing of wine & cider.
40. Vinegar - types - methods of preparation - problems in vinegar production.
41. Un-fermented beverages - concept & standards - process (Juices, Ready to serve, nectar, cordial, squash, crush, syrup, fruit juice concentrate, fruit juice, powder, barely water and carbonated beverages).
42. Tomato processing - Concepts and Standards - Tomato juice - Tomato puree and paste Tomato sauce/ketchup - Tomato chutney/pickle - Tomato cocktail - Tomato soup - Canned tomatoes.
43. Drying/dehydration of fruits and vegetables - definition - Factors affect the rate of drying - Process - advantages of dehydration over sun drying.
44. Spoilage of dried fruits and vegetables during storage and prevention methods.
45. Common dryers used for dehydration of fruits and vegetables - application - merits & demerits.
46. Osmotic dehydration of fruits and vegetables - definition - Process - advantages and disadvantages.
47. Bottling of fruits and vegetables - types of glass container - process - merits and demerits.
48. Canning of fruits and vegetables - selection of fruits and vegetable - process - tin containers - causes of spoilage of canned foods.

Practical

Applications of different types of packing, 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, jelly, RTS, nectar, squash, osmotically dried products, fruit bar candy and tomato products, canned products. Quality evaluation of products- Physico-chemical and sensory. Visit to processing unit/industry.

Practical Schedule

1. Application of different packaging materials and methods for shelf life extension of fruits and vegetables.
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 and quality evaluation of jam.
6. Preparation and quality evaluation of jelly.
7. Preparation and quality evaluation of RTS.
8. Preparation and quality evaluation of nectar.
9. Preparation and quality evaluation of squash.

10. Preparation of osmotically dried products - candy.
11. Preparation and quality evaluation of fruit bar.
12. Preparation of tomato ketchup.
13. Preparation of tomato pickle.
14. Preparation and quality evaluation of canned products.
15. Quality evaluation of products - (physic-chemical and sensory).
16. Visit to processing unit/ industry.
17. **Final Practical Examination**

Suggested Readings:

1. Post-harvest technology of horticultural crops by S.K. Sharma and M.C Nautiyal.
2. Post-Harvest Technology by Suja Nabi Qureshi, Kounsar Javeed and Abhay Kumar Sinha. Bioscientific Publishers.
3. Postharvest Technology of Horticultural Crops by K.P. Sudheer and V. Indira. New India, Publishing Agency. 320p.
4. Postharvest Management and Value Addition by Aswini Kumar Goel, Rajender Kumar and Satwinder S. Mann. Daya Publishing House.
5. Postharvest Management and Value Addition of Fruits and Vegetables by Kureel M.K. Biotech, 181p.

Course No.	:	SAC 401
Course Title	:	Management of Natural Resources
Credit Hours	:	3+1
Course Category	:	Elective Course

Course Learning Rationale / Course Objective (CLR)

The purpose of learning this course is to

1. Understand the concept of natural resources, classification
2. Knowledge on types of natural resources
3. Knowledge on water ecology and management, energy resources
4. To know about approaches in resource management
5. Understand about types of erosion and management

Course learning objectives (CLO):

1. To enlighten students about available natural resources and their relationship with crop production
2. To impart the knowledge of principles and practices of natural resource management

THEORY**Unit 1: Natural Resources**

Introduction to Natural Resource Bases: Concept of resource, classification of natural resources. Factors influencing resource availability, distribution and uses. Interrelationships among different types of natural resources. Concern on Productivity issues. Ecological, social and economic dimension of resource management. Land resources: Land as a resource. Dry land, land use classification, land degradation, man induced landslides,

Unit 2: Soil Erosion, water ecology and management

Soil erosion and desertification. Landscape impact analysis, wetland ecology and management. Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems. Water ecology and management.

Unit 3: Energy resources, management

Energy resources: Growing energy needs, renewable and nonrenewable energy sources, use of alternate energy sources. Resource Management Paradigms: Resource management the evolution and history of resource management paradigms. Resource conflicts: Resource extraction, access and control system. Approaches in Resource Management: Ecological approach; economic approach; ethnological approach; implications of the approaches; integrated resource management strategies.

Unit 4: Soil conservation

Introduction to soil and water conservation and causes of soil erosion. Definition and agents of soil erosion, water erosion, forms of water erosion, gully classification and control measures. Soil loss estimation by universal soil loss equation, soil loss measurement techniques. Principles of erosion control, introduction to contouring, strip cropping. Contour bund, graded bund and bench terracing. Wind erosion, mechanics of wind erosion, types of soil movement, principles of wind erosion control and its control measures.

Unit 5: Water conservation, Micro irrigation and drainage

Water harvesting techniques, runoff computation, rational formula, lining of ponds, tanks and canal systems, watershed concept, integrated approach and management. Micro irrigation, types and components, irrigation automation, agricultural drainage - surface and sub-surface drainage systems - drainage coefficient- Types of wells, pump types, reciprocating pumps, centrifugal pumps –submersible pumps – jet pumps – airlift pumps.

Theory - Lecture Schedule

1. Introduction to Natural Resource- Basic concepts
2. Concept of resource, classification of natural resources.
3. Factors influencing resource availability, distribution and uses.
4. Interrelationships among different types of natural resources.
5. Concern on Productivity issues.
6. Ecological, social and economic dimension of resource management.
7. Land resources: Land as a resource.
8. Dry land, land use classification,
9. Land degradation, man induced landslides
10. Soil erosion and desertification.
11. Landscape impact analysis
12. Wetland ecology and management.
13. Water resources: Use and over-utilization of surface and ground water
14. Floods - Types, characters and management
15. Drought - Types, characters and management
16. Conflicts over water – State, National and International level
17. Dams-benefits and problems.
18. Water ecology and management.
19. Energy resources: Growing energy needs
20. Renewable energy sources – Types, Characters and its management
21. Nonrenewable energy sources - Types, Characters and its management
22. Use of alternate energy sources
23. Resource Management Paradigms
24. Resource management the evolution and
- 25. Mid Semester Examination**
26. History of resource management paradigms.
27. Resource conflicts: Resource extraction, access and
28. Control system of Resource conflicts
29. Approaches in Resource Management, concepts
30. Ecological approach; economic approach; ethnological approach
31. Implications of the approaches
32. Integrated resource management strategies.
33. Introduction to soil erosion, factors affecting soil erosion, causes and evil effects of soil erosion, mechanics of soil erosion, types of soil erosion
34. Water erosion - causes - stages of water erosion - splash, sheet, rill and gully erosion
35. Gully formation, stages of gully and classification
36. Wind erosion - factors influencing wind erosion - mechanics of wind erosion – suspension, saltation, surface creep - effects of water and wind erosion
37. Universal soil loss equation – soil loss measurement techniques

38. Erosion control measures for agricultural lands – biological measures – contour cultivation – strip cropping – crop rotation - mulching
39. Wind erosion control measures- vegetative barriers - windbreaks and shelterbelts
40. Mechanical measures – contour bund – graded bund - Broad beds and furrows – gully control measures
41. Mechanical measures for hill slopes – contour trench – bench terrace – contour stone wall
42. Rain water harvesting – runoff computation - rational formula – runoff coefficient
43. Runoff water harvesting - farm ponds and percolation ponds.
44. Watershed concept – Integrated approach and management
45. Micro irrigation – types of micro irrigation and their components
46. Irrigation automation – Time based, volume based and sensor based system
47. Agricultural drainage – need – surface and subsurface drainage systems - drainage coefficient
48. Types of Pumps– reciprocating pumps – centrifugal pumps – submersible pumps - Jet pumps – Airlift pumps

Practical

Identifying natural resources and their utility. Practicing survey - Principles and educating to use pacing technique for measurement. Area calculations through chain survey - GPS demo for tracking and area measurement. Estimation of soil loss and calculation of erosion index. Leveling concepts and practical utility in agriculture. Preparation of contour maps. Concept of vegetative water ways and design of grassed water ways. Wind erosion and estimation process. Different irrigation pumps and their constructional differences. Farm pond construction and its design aspects. Visit to nearby farm pond. Visit to an erosion site. Exposure to strip cropping/contour bunding.

Practical – Schedule

1. Identification of natural resources and their utility
2. Study of survey instruments
3. Study of leveling instruments.
4. Chains and cross staff surveying - linear measurement - plotting and finding areas.
5. Compass survey - observation of bearings - computation of angles.
6. Determination of difference in elevation by using dumpy level.
7. GPS demonstration and area measurement
8. Estimation of soil loss using USLE
9. Calculation of erosion index
10. Design of contour bund.
11. Design of bench terracing system.
12. Preparation of contour maps
13. Design of grassed waterways

14. Problems on wind erosion.
15. Study of different irrigation pumps
16. Visit to a Nearby Farm Pond

17. Final Practical Examination

Suggested Readings:

1. Sustainable Natural Resource Management by Danill R. Lynch.
2. Management of Natural Resource for Sustainable Development, by Vijay Singh Rathor and B S Rathor, Daya Publishing House.
3. Managing Natural Resources: Focus on Land and Water. Ed. Harikesh N. Mishra. PHI, Learning, 496p.
4. Management of Resources for Sustainable Development: Sushma Goel. The Orient Blackswan, 284p.
5. Natural Resources: Their Conservation and Management by Arvind Rai Upadhyay. Aspiration Academy, 320p.
6. Natural Resource Management for Growth Development and Sustainability by Vasudeva Srishti Pal. Today & Tomorrows Printers and Publishers, 336p.

Course No.	:	SAC 402
Course Title	:	Agrochemicals
Credit Hours	:	3+1
Course Category	:	Elective Course

Course Learning Rationale / Course Objective (CLR):

The purpose of learning this course is to

1. Understand the use of different agrochemicals in agriculture.
2. Knowledge of herbicides, insecticides, their mode of action and manufacture
3. Understanding the botanicals and fate of pesticides in agro ecosystem
4. Knowledge of fertilizers, classification, manufacture and their reaction in soil
5. To know about the mixed and complex fertilizers, Fertilizer logistic and marketing.

Course Learning Objectives (CLO):

1. Key concepts in insecticides, fungicides and herbicides
2. Characterization of different fertilizers and their manufacture
3. Knowledge about botanicals, bio-pesticides and their characters

THEORY

Unit 1: Introduction to Agrochemicals - types and management, Herbicides, Inorganic 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. Herbicides - Major classes, properties and important herbicides. Fate of herbicides. Fungicides - classification - Inorganic fungicides - characteristics, preparation and use of sulphur and copper. Mode of action - Bordeaux mixture and copper oxychloride.

Unit 2: Organic Fungicides and Insecticides

Organic fungicides - Mode of action - Dithiocarbamates - characteristics, preparation and use of Zineb and Maneb. Systemic fungicides - Benomyl, carboxin, oxycarboxin, Metalaxyl, Carbendazim, characteristics and use. Introduction and classification of insecticides: Inorganic and organic insecticides Organochlorines, Organophosphates, Carbamates, Synthetic pyrethroids - Neonicotinoids, Biorationals.

Unit 3: Insecticide act, Biopesticides, Botanicals

Insecticide Act and rules, Insecticides banned, withdrawn and restricted use. Fate of insecticides in soil and plant. IGR Biopesticides, Reduced risk insecticides, Botanical, Plant and animal systemic insecticides, their characteristics and uses. Plant bio-pesticides for ecological agriculture, Bio-insect repellent.

Unit 4: Fertilizers and their classification and manufacture

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 potassium chloride, potassium sulphate and potassium nitrate.

Unit 5: Mixed and Complex fertilizers, Fertilizer logistic and marketing, Plant bio-pesticides

Mixed and complex fertilizers: Sources and compatibility - preparation of major, secondary and micronutrient mixtures. Complex fertilizers: Manufacturing ammonium phosphates, nitro phosphates and NPK complexes. Fertilizer control order. Fertilizer logistics and marketing.

Theory - Lecture Schedule

1. An introduction to agrochemicals, their type and role in agriculture.
2. Effect of agro chemicals on the environment, soil, human and animal health.
3. Merits and demerits of uses of agrochemicals in agriculture.
4. Management of agrochemicals for sustainable agriculture.
5. Herbicides -Major classes, properties and important herbicides.
6. Fate of herbicides in soil, plant, water and environment system.

7. Fungicides and their classification
8. Inorganic fungicides and their characteristics
9. Preparation and use of sulphur and copper fungicides
10. Mode of action of Bordeaux mixture and Copper oxychloride.
11. Organic fungicides, Mode of action – Dithiocarbamates - Characteristics, preparation and use of Zineb and Maneb.
12. Systemic fungicides - Benomyl, carboxin, oxycarboxin, Metalaxyl, Carbendazim, characteristics and use.
13. Introduction and classification of insecticides
14. Inorganic and organic insecticides – Organochlorine insecticides, characteristics, mode of action and manufacture.
15. Organophosphates insecticides, characteristics, mode of action and manufacture.
16. Carbamate insecticides, characteristics, mode of action and manufacture.
17. Synthetic pyrethroids – Neonicotinoids – Characters, mode of action, manufacture and uses.
18. Biorationals and their characters, uses and mode of action
19. Insecticide Act and rules
20. Insecticides - banned, withdrawn and restricted for commercial usage.
21. Fate of insecticides in soil, water, plants and environment.
22. IGR and Biopesticides, their manufacture, mode of action and uses.
23. Reduced risk insecticides and their characters, mode of action and uses
24. Botanical, plant and animal systemic insecticides, their characteristics and uses.
- 25. Mid Semester Examination**
26. Plant bio-pesticides for ecological agriculture
27. Plant bio-pesticides and their characters, mode of action and manufacture
28. Bio-insect repellent - characters, mode of action, impact on environment
29. Fertilizers - definition and their classification
30. Fertilizers and their importance in agriculture
31. Nitrogenous fertilizers: Feedstocks and Manufacturing of ammonium sulphate and ammonium nitrate.
32. Feedstocks and manufacture of ammonium chloride and urea, their environmental impact in soil
33. Slow-release N-fertilizers and their characters, manufacturing processes
34. Phosphatic fertilizers: feedstock and manufacturing of single superphosphate, their characters,
35. Preparation of bone meal and basic slag, reaction in soil
36. Potassic fertilizers and their natural sources of potash
37. Manufacture of potassium chloride, uses, impact in soil, plant and water environment
38. Manufacture of potassium sulphate, uses, impact in soil, plant and water environment

39. Manufacture of potassium nitrate, uses, impact in soil, plant and water environment
40. Mixed and complex fertilizers, their characters, manufacture
41. Environmental impact of mixed and complex fertilizers in environment and soil health
42. Sources and compatibility of complex fertilizers
43. Preparation of major, Secondary and micronutrient mixtures.
44. Complex fertilizers: Manufacturing of ammonium phosphates and nitro phosphates
45. NPK complexes and their characters.
46. Important complex fertilizers and their manufacture
47. Fertilizer control order
48. Fertilizer logistics and marketing.

Practical

Sampling of fertilizers and pesticides. Pesticides application technology to study 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.

Practical Schedule

1. Sampling of fertilizers and pesticides.
2. Pesticides application technology to study various pesticide appliances.
3. Calculation of doses of insecticides to be used.
4. Calculation of doses of herbicides and fungicides.
5. Calculation of fertilizer doses for crops.
6. To study and identify various formulations of insecticide available in market.
7. Quick tests for identification of common fertilizers.
8. Identification of anion and cation in fertilizer.
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
13. Estimation of Sulphate of Potash by flame photometer.
14. Determination of copper content in copper oxychloride.
15. Determination of sulphur content in sulphur fungicide.
16. Visit to pesticide and fertilizer testing laboratory.
- 17. Final Practical Examination**

Suggested Readings:

1. Buchel, K.H. (Ed.). 1992. Chemistry of pesticides. John Wiley & Sons
2. Panda, H. 2022. The Complete Technology Book on Pesticides, Insecticides, Fungicides and Herbicides (Agrochemicals) with Formulae, Manufacturing Process, Machinery & Equipment Details. 2nd Revised Edition. NPCS.
3. Biswas, D. R. 2021. A Text Book of Fertilizers. New India Publishing Agency
4. Singh, A. 2022. Basics of Agrochemical Formulations, Brillion Publishing, 176p.
5. Larramendy, M.L. 2017. Toxicity and Hazard of Agrochemicals, INTECH, 170p.
6. Handa, S.K. 2004. Principles of Pesticide Chemistry. Agrobios
7. Cremlyn, R.J. 1991. Agrochemicals Preparation and mode of action. John Wiley and sons, New York.
8. George W. Ware, 1986. Fundamentals of Pesticides - A Self Instruction Guide Thomas Publications, PO Box. 9335, Fresno, California 93791.
9. Robert White, Stevens, 1971. Pesticides in the Environment Vol. I and Part I Marcel Dekker Inc., New York.
10. Sree Ramulu, U.S. 1979. Chemistry of Insecticides and Fungicides Oxford and IBH Publishing Co., New Delhi.
11. Gupta, A. 2006. Pesticide Residue in Food commodities. Agrobios
12. John Havlin, James Beaten, Samuel Tisdale, Werner Nelson, 2014. Soil Fertility and Fertilizers
13. An Introduction to Nutrient Management. 8th Edition, Prentice Hall. Upper Saddle River, NJ.
14. Yawalkar, K.S., J.P. Agarwal and S. Bokde. 1972. Manures and Fertilizers Third revised edition Agri Horticultural Publishing House, Nagpur.

Course No.	:	SST 401
Course Title	:	Commercial Seed Production
Credit hours	:	3+1
Course category	:	Elective course

Course Learning Rationale / Course Objective (CLR):

1. To introduce the basic principles of seed and planting material production on a commercial scale.
2. To provide knowledge about seed quality, certification, and testing procedures.
3. To train students in hybrid seed production techniques for field and horticultural crops.
4. To develop understanding of seed processing methods and equipment handling.
5. To expose students to seed marketing strategies and modern biotechnological tools like micro propagation and synthetic seed production.

Course Learning Outcomes (CLO):

1. Identify and apply suitable methods for commercial seed and planting material production.
2. Operate and manage seed processing, drying, and treating equipment effectively.
3. Implement seed certification standards and conduct field inspections.
4. Perform seed quality testing, including germination, purity, and health assessments.
5. Demonstrate skills in tissue culture techniques and synthetic seed preparation.

THEORY**Unit 1: General Principles of Seed Production**

Raising the seed crop, Introduction, Procurement of a class of Improved seeds, Reporting to Monitoring or certification Agency. Principles and practices of selection of area and agronomic requirement of seed production of field crops. Importance of isolation distance and Roguing. Principles of hybrid seed production in field crops. Principles and practices of selection of area and agronomic requirement of seed production of horticultural crops. Concept of apomixes, male sterility and self-incompatibility and its application in hybrid seed production of horticultural crops. Farmers participatory seed production.

Unit 2: General Principles of Seed Processing

Introduction, Objectives of Seed Processing, Seed Drying, Principles of drying, Water vapour equilibrium, Methods of drying seeds. Cleaning and grading, Air and screen machines, Dimensional separators, Density separators, Surface texture separators, Colour separators, Spiral separators, Electric separators, Vibrator separators, Separation based on Affinity to liquids. Seed treatment, Temperature treatment, Chemical treatment, Bagging and Labelling.

Unit 3: General Principles of Seed Testing

Seed testing - Introduction, Procedure of Seed testing, components of seed quality testing genetic, physical, physiological and seed health testing, Seed sampling, Types of seed sampling, Requirements of sampling. Concept of seed viability and vigour; dormancy, types and principles of seed dormancy, Physiological quality of seed, Principles of seed Germination, types of germination, biochemical and genetic basis.

Unit 4: Seed Certification, Seed Industry and Seed Marketing

History, concept and objectives of seed certification; seed certification agency/organization and staff requirement Indian Minimum Seed Certification Standards (I.M.S.C.S.) - general and specific crop standards including GM varieties, field and seed standards. Introduction, Evolution of the seed industry, Development of the vegetable and Flower seed industry, Seed marketing – concept, definition and purpose, importance and promotion of quality seed, formal and informal seed supply systems, Seed marketing intelligence and product mix, sales promotion, distribution channels, marketing costs and margins; packaging and labelling, Seed Associations, Factors influencing seed marketing, Seed marketing programs, Seed industry organizations, Marketing of public versus

private players, Demand and supply of seed; role of seed replacement rate (SRR), seed multiplication ratio (SMR), economics of seed production; determining seed needs, Seed pricing and price policy, seed processing and / packaging, demand forecasting and factors affecting demand for seeds, effect of price and farm income on seed demand, Role of WTO in seed marketing.

Unit 5: Biotechnology in Seed Technology

History of plant tissue culture, Laboratory organization, Composition of nutrient medium, Micro-propagation, Axillary bud proliferation approach, Meristem and shoot tip culture, Bud culture, Advantages of Micro-propagation, Problems associated with micro-propagation, Synthetic seed production, Types of synthetic seeds, methods of development of synthetic seeds, Components of nutrient media for synthetic seed development, Storage of synthetic seeds, Advantages and limitations of synthetic seed production.

Practical

Planning of Seed Production, requirements for different classes of seeds in field crops - unit area and rate. Operation and handling of mechanical drying equipment; effect of drying temperature and duration on seed germination and storability seed processing equipment; seed treating equipment. Seed production in cross pollinated crops with special reference to land, isolation, Planting ratio of male and female lines, synchronization of parental lines and methods to achieve synchrony; supplementary pollination, pollen storage, hand emasculation and pollination in tomato, Hybrid seed production in Maize, detasseling in maize, identification of rogues and pollen shedders, Pollen collection, storage, viability and stigma receptivity; gametocide application and visits to seed production plots *etc.*, Visit to seed processing plant and commercial controlled and uncontrolled Seed Stores, Seed industries and local entrepreneurs visit to nearby areas, Different methods of examination of seeds to assess seed-borne microorganisms and to quantify infection percentage, detection of seed-borne fungi, bacteria and viruses, identification of storage fungi, control of seed borne diseases, seed treatment methods., Maintenance of aseptic conditions and sterilization techniques, Preparation of nutrient stocks for synthetic media, Selection of explants for callus induction, Preparation of MS medium for micro-propagation and Callus induction, Selection of explants for callus induction, Preparation of MS medium for micro-propagation and Callus induction, Inoculation of explants for micro-propagation, Inoculation of explants for callus induction and subsequently regeneration of plantlets from matured seeds of field and horticultural crops, Synthetic seed preparation.

Theory - Lecture Schedule:

1. Raising the seed crop, Introduction, Procurement of a class of Improved seeds and Reporting to Monitoring or certification Agency.
2. Principles and practices of selection of area and agronomic requirement of seed production of field crops.
3. Importance of isolation distance and Roguing.
4. Principles of hybrid seed production in field crops.
5. Principles and practices of selection of area and agronomic requirement of seed production of horticultural crops.

6. Concept of apomixes, male sterility and self-incompatibility and its application in hybrid seed production of horticultural crops.
7. Farmers participatory seed production.
8. Seed Drying, Principles of Drying - Water vapour equilibrium - Methods of drying seeds
9. Introduction and objectives of Seed processing.
10. Cleaning, grading and upgrading - Air and screen machines, Dimensional separators, Density separators, Surface texture separators,
11. Upgrading machines - Colour separators, Spiral separators, Electric separators, Vibrator separators, Separation based on Affinity to liquids.
12. Seed treatment - Temperature treatment - Chemical treatment - Bagging and Labelling.
13. Seed sampling - Types of seed sampling - Requirements of sampling.
14. Seed testing - Introduction - Procedure of Seed testing - concepts.
15. Physical purity analysis, determination of other distinguishable varieties (ODV) and test weight determination.
16. Procedures, types and methods of seed germination test - biochemical and genetic basis.
17. Dormancy – types, principles of seed dormancy and breaking treatments.
18. Principle and procedure of viability test.
19. Concept of seed vigour and vigour tests; principles and methods of physical, physiological and stress vigour tests
20. Principles and procedures of genetic purity assessment.
21. Principles and methods of seed health testing.
22. History, concept and objectives of seed certification.
23. Seed certification agency/organization and staff requirement.
24. Indian Minimum Seed Certification Standards (I.M.S.C.S.) - general and specific crop standards including GM varieties, field standards - agricultural crops.
25. **Mid Semester Examination**
26. Indian Minimum Seed Certification Standards (I.M.S.C.S.) - general and specific crop standards including GM varieties, seed standards - agricultural crops.
27. Indian Minimum Seed Certification Standards (I.M.S.C.S.) - general and specific crop standards including GM varieties, field standards - horticultural crops.
28. Indian Minimum Seed Certification Standards (I.M.S.C.S.) - general and specific crop standards including GM varieties, seed standards - horticultural crops.
29. Introduction and Evolution of the seed industry.
30. Development of the vegetable and Flower seed industry.
31. Seed marketing – concept, definition and purpose,
32. Importance and promotion of quality seed.
33. Formal and informal seed supply systems.

34. Seed marketing intelligence and product mix, sales promotion, distribution channels, marketing costs and margins.
35. Factors influencing seed marketing.
36. Seed marketing programs.
37. Marketing of public versus private players.
38. Demand and supply of seed; role of seed replacement rate (SRR), seed multiplication ratio (SMR).
39. Economics of seed production; determining seed needs-Seed pricing and price policy.
40. Seed demand forecasting and factors affecting demand for seeds, effect of price and farm income on seed demand.
41. Seed packaging- Types.
42. Seed Associations and Seed industry organizations.
43. Role of WTO in seed marketing.
44. History of plant tissue culture, Laboratory organization, Composition of nutrient medium.
45. Micro-propagation, Axillary bud proliferation approach, Meristem and shoot tip culture, Bud culture - Advantages of Micro-propagation- Problems associated with micro-propagation.
46. Synthetic seed production, Types of synthetic seeds, methods of development of synthetic seeds.
47. Components of nutrient media for synthetic seed development.
48. Storage of synthetic seeds - Advantages and limitations of synthetic seed production.

Practical Schedule

1. Planning of seed production - season and land selection - assessment of seed source and seed selection.
2. Requirements for different classes of seeds in field crops - unit area and rate
3. Operation and handling of mechanical drying equipment.
4. Effect of drying temperature and duration on seed germination and storability-seed processing equipments - Seed treating equipments.
5. Seed production in cross pollinated crops with special reference to land, isolation, Planting ratio of male and female lines.
6. Synchronization of parental lines and methods to achieve synchrony.
7. Supplementary pollination, Detasseling in maize and Hand emasculatation and pollination in tomato.
8. Identification of rogues and pollen shedders - Pollen collection, storage, viability and stigma receptivity.
9. Visits to seed production plots.
10. Visit to seed processing plant.
11. Visit to commercial controlled and uncontrolled seed stores.
12. Visit to seed industries and local entrepreneurships in nearby areas.

13. Different methods of examination of seeds to assess seed-borne microorganisms and to quantify infection percentage – detection and identification
14. Maintenance of aseptic conditions and sterilization techniques and Preparation of nutrient stocks for synthetic media.
15. Selection of explants for callus induction - Preparation of MS medium for micro-propagation and Callus induction and Inoculation of explants for callus induction and subsequently regeneration of plantlets from matured seeds of agriculture and horticultural crops.
16. Synthetic seed preparation.
17. **Final Practical Examination.**

Suggested Readings:

1. McDonald, M.B. Jr and Copeland, L.O. 1997. Seed Production: Principles and Practices. Chapman & Hall
2. Thompson, J.R. 1979. An Introduction to Seed Technology. Leonard Hill.
3. Singhal, N.C. 2003. Hybrid Seed Production in Field Crops. Kalyani.
4. Justice, O.L. and Bass, L.N. 1978. Principles and Practices of Seed Storage. Castle House Publ. Ltd.
5. Tunwar, N.S. and Singh S.N. 1988. Indian Minimum Seed Certification Standards. CSCB, Ministry of Agriculture, New Delhi.
6. Chawla, H.S. 2008. Introduction to Plant Biotechnology. 2nd edn. Oxford & IBH publishing Co. Ltd. 113-B Shahpur Jat, New Delhi-110049.
7. Redenbaugh, K. 1993. Synseeds: Application of Synthetic Seeds to Crop Improvement. CRC Press, London, UK.

VIII SEMESTER

Sl.No.	Course No.	Course Title	Cr.Hr.
1.	RAE 401	Rural Agricultural Work Experience and Agro-industrial Attachment (RAWE & AIA)	0 + 20
		TOTAL	0 + 20

Course No.	:	RAE 401
Course Title	:	Rural Agricultural Work Experience and Agro-industrial Attachment (RAWE&AIA)
Credit Hours	:	0+20
Course Category	:	Student READY

RAE 401: Rural Agricultural Work Experience and Agro-Industrial Attachment (RAWE & AIA) (0+20) - 120 days

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.

Sl. 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
Total days for RAWE & AIA		120	0+20

(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
Total		59 days

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, back yard 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	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
Total Marks			200

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:

S.No.	Activity	No. of days
1	KVK attachment	6
2	Research Station attachment	6
3	NGO attachment	6
4	ATMA/State Agrl. Department	6
	Total	24

Evaluation pattern for Unit attachment: The following is the evaluation pattern for unit attachment.

S.No.	Items	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
	Total Marks	80

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	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
Total		40

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:

S.No	Criteria	Marks
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
Total		80

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

SKILL ENHANCEMENT COURSES (SEC)

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

Course No.	:	SEC 001
Course Title	:	Agricultural Waste Management
Credit Hours	:	0+2
Course Category	:	Skill Enhancement Course

Course Learning Rationale / Course Objective (CLR):

1. The courses may be offered as module of complementing courses to help the student to achieve skill in a specific area of his interest.
2. For the prospect of local employment and entrepreneurship development.

Course Learning Outcomes (CLO):

1. To impart knowledge on various aspects of biowastes and agricultural wastes for managing as organic amendments in agricultural production system.
2. To develop skills on various methods of conversion of decomposable wastes into organic manures.

Practical

Organic waste and its use: Introduction to agricultural waste management, type of wastes, and sources of agriculture waste. Visit of different agriculture waste management units, Collection, transport, sorting, treatment, storage and utilization of Agriculture Wastes, Preparation of Organic Manures from agriculture Wastes, Production of compost by aerobic and anaerobic methods from agriculture waste, Enriched compost production from agriculture waste, Production of Vermicompost from agriculture wastes, Production of enrich vermicompost from agriculture waste. Biogas Production Technology: Biogas Production from Agriculture waste and utilization of slurry, Production of enriched biogas slurry, Collection and preparation agricultural waste sample for analysis, Quality analysis (N, P and K) of manure, compost, vermicompost and biogas slurry. Collection and preparation agricultural waste sample for analysis. Quality analysis (N, P and K) of manure, compost, vermicompost and biogas slurry. Recommended doses and application of manure, compost, vermicompost and biogas slurry for major crops and others.

Practical Schedule

- 1,2. Introduction – agricultural wastes – source segregation methods -methods of collection and storage of agricultural wastes
- 3,4. Different agricultural production systems – types of wastes generated – quantification and classification of wastes – methods of waste processing - reporting
- 5,6. Visit to a Landfill site – Study about volume, size and Chemical reduction techniques -leachate treatment facilities

- 7,8. Visit to a Landfill site – assessment of pollution problems - Garbage to Green – Converting landfills to parks
- 9,10. Composting –principles - factors affecting composting- different methods of composting-aerobic - windrow compost preparation - aerated static pile composting
- 11,12. Other methods of composting – preparation of different types of compost – Sheet composting –In vessel composting – biodynamic composting - pipe composting
- 13,14. Preparation of compost by trench method- NADEP compost - anaerobic composting –merits- demerits. Use of microorganisms in composting - Microbial composts –EM compost - Preparation of Coir pith compost - production technologies.
- 15,16. Preparation of Vermi compost - mass multiplication of earthworms- indoor vermicomposting (small scale). Outdoor vermicomposting (commercial scale) - insitu vermicomposting.

17. Mid Semester Examination

- 18,19. Rapid thermo chemical processing of agricultural wastes- Pyrolysis -Biochar production by the process of pyrolysis from organic waste.
- 20,21. Biogas plants – different types – designs – visit to nearby biogas production unit and study the operation and production of biogas –advantages – disadvantages - prepare lay out plan
- 22,23. Use of agricultural wastes in preparation of bio fertilizers. Value addition of products - enriched manures - production with biotic and abiotic components
- 24,25. Quality parameters of organic manures and specifications - procedure for collection of manure samples- solid and liquid manures.
- 26,27. Liquid organic manures- vermiwash, compost tea, biogas slurry- preparation – enrichment and uses – Other uses of agricultural wastes
- 28,29. Evaluation of compost maturity - maturity indices of compost
Determinations - C:N ratio, temperature, colour, odour moisture content, pH, EC and nutrient contents (N, P, K, Ca, Mg, Fe, Mn, Zn, Cu),
- 30,31. Rapid test for assessing microbial load, detection of pathogens and hazardous heavy metals (Ni, Pb, Cd, As, Hg)
Compost stability test-microbial respiration of CO₂ – (germination test)
- 32,33. Preparation of project proposal and work plan for establishing commercial organic manures, production unit- report preparation.

34. Final Practical Examination

Suggested Readings:

1. Ashworth, G.S. and Azevedo, P. 2009. Agricultural Wastes. Nova Science Publishers.
2. Cheng, H. H (ed.). 1990. Pesticides in the Soil Environment: Processes, Impacts, and Modeling. SSSA-ASA, Inc., Madison, WI.

3. Das, P.C. 1993. Manures and Fertilizers. Kalyani Publishers, New Delhi.
4. Gupta P.K. 2006. Vermi composting for Sustainable Agriculture. Published by AGROBIOS (India) Jodhpur
5. Powers, J. F. and Dick, W.P. 2000. Land Application of Agricultural, Industrial, and Municipal By-products. SSSA-ASA, Inc., Madison, WI
6. Ramachandra T.V. 2006. Soil and Groundwater Pollution from Agricultural Activities. Commonwealth of Learning, Canada and Indian Institute of Science, Bangalore
7. Rattan Lal (ed).2001. Soil carbon sequestration and the greenhouse effect. SSSA Special publication number 57, SSSA Inc. Madison, WI
8. Sharma, A.K. 2005. Biofertilizers for Sustainable Agriculture. Published by AGROBIOS(India) Jodhpur
9. Stoffella, P. J. and Khan, B.A (ed.). 2001. Compost Utilization in Horticultural Cropping Systems. Lewis Publishers, Boca Raton, FL
10. Tandon, H.L.S. 1992. Fertilizers, Organic Manures, Recyclable Wastes and Biofertilizers. Fertilizer Development and Consultation Organization.
11. Tandon, H.L.S. 1993. Methods of Analysis of Soils, Plants, Waters and Fertilizers. Fertilizer Development and Consultation Organization.143p.
12. Yawalkar, K.S., Agrawal, J.P. and Bokde,S. 1981. Manures and Fertilizers.
13. Bhatnagar, R.K. and Palta, R.K. (2002). Vermiculture and vermicomposting. Kalyani
14. Publishers, Ludhiana.
15. Clive A. Edwards, Norman Q. Arancon, and Rhonda L. Sherman (2011). "Vermiculture Technology: Earthworms, Organic Wastes, and Environmental Management". CRC Press.
16. M. Devender Reddy, Mandapati Roja, Ch. Deepthi (2019). Agricultural Waste Management. Kalyani Publishers, Delhi.
17. Thelma Bosso (2016). Agricultural Waste Management. Callisto Publishers, U.K.
18. Vir Singh, Poonam Gusain, Meenakshi Arya (2018). Agro Waste Management, SSDN Publishers.

Web -References:

1. <http://www.eartheasy.com>
2. <http://www.composting council.org>
3. <http://www.Epa.gov/compost>

Course No.	:	SEC 002
Course Title	:	Biofertilizer and Biopesticide production
Credit Hours	:	0+2
Course Category	:	Skill Enhancement Course

Course Learning Rationale / Course Objective (CLR):

To enable students to gain knowledge and hands-on-experience in bioinoculant and biopesticide production technology and establish a commercial unit.

Course Learning Outcomes (CLO):

Knowledge and hands-on-experience in use bioinoculants and biopesticide production techniques and establish a commercial unit.

Practical Schedule

1. Biofertilizers - types, production and demand in India; Importance and contribution of biofertilizers in Agriculture and allied sectors. Facilities and equipments required for laboratory scale, pilot scale and large scale biofertilizer production (liquid and carrier) –principles and specifications.
2. Isolation, purification and characterization of nitrogenous biofertilizers – Rhizobium, Azospirillum, Azotobacter and Gluconoacetobacter.
3. Isolation, purification and characterization of nitrogenous biofertilizers – Azotobacter and Gluconoacetobacter.
4. Isolation, purification and characterization of phosphate solubilizing bacteria.
5. Isolation, purification and characterization of zinc solubilizing and potassium releasing bacteria.
6. Isolation, purification and characterization of plant growth promoting bacteria - Pink Pigmented Facultative Methylophilic (PPFM) and screening of PPFM.
7. Preparation of medium and carrier material for large scale production.
8. Mass production of nitrogenous based bio-fertilizers (Rhizobium and Azospirillum).
9. Mass production of nitrogenous based bio-fertilizers (Azotobacter and Gluconoacetobacter).
10. Mass production of phosphate solubilizing bacteria.
11. Mass production of zinc solubilizer and potassium releasing bacteria.
12. Mass production of PPFM
13. Isolation of AM spores from soil and morphological characterization of AM spores. Selection of efficient AM fungi by plant infection tests.
14. Mass Production of Arbuscular Mycorrhizal (AM) Fungal Biofertilizer
15. Mass production of Azolla and BGA.

16. BIS standards / Fertilizer Control Order – Specifications and quality control measures for various biofertilizers.
17. **Mid Semester Examination**
18. Storage and preservation of various microbial cultures. Shelf life and storage of biofertilizers.
19. Constraints in mass production of various biofertilizers. Study of plant response to biofertilizers- visit to biofertilizer inoculated fields
20. Formulation development for production of fixed quantity of various biofertilizers.
21. Biofertilizers - Organic certification – processes to be followed – Agencies for Certification.
22. Exposure to advanced techniques in biofertilizer production - Tangential Flow Filtration, lyophilized cells production and automatic packing unit.
23. Economics of biofertilizer production.
24. Calculation of commercial production cost – fixed cost- cost of building, equipments and glasswares and variable cost - raw materials, maintenance, labour cost etc.,
25. Preparation of culture Media for the isolation of biocontrol agents.
26. Isolation of biocontrol agents - *Trichoderma asperellum*, *Metarhizium*, *Pseudomonas fluorescens* and *Bacillus subtilis*.
27. Assessing the in vitro antagonistic activity of biocontrol agents.
28. Mass multiplication of fungal biocontrol agents - *Trichoderma asperellum* and *Metarhizium*.
29. Mass multiplication of bacterial biocontrol agents - *Pseudomonas fluorescens* and *Bacillus subtilis*.
30. Quality control standards and shelf-life evaluation of biocontrol Agents.
31. Visit to commercial biofertilizer and biocontrol production unit.
32. Identification of botanicals for pest management.
33. Identification of entomopathogenic microorganisms infected cadavers in field condition. Mass production of entomopathogens
34. **Final Practical Examination**

Suggested Readings:

1. Motsara, M.R., Bhattacharyya, P., and Beena Srivastava. 2004. Biofertilizer Technology, Marketing and Usage – A source book- Cum -Glossary
2. Somani L.L., 2011. Biofertilizers: Commercial Production Technology and Quality Control Publishers:
3. NIIR 2012. The Complete Technology Book on Biofertilizer and Organic Farming NIIR Project Consultancy Services, New Delhi. P. 608. (ISBN: 9789381039076)
4. Reeta Khosla 2017. Biofertilizers and Biocontrol Agents for Organic Farming, Publishers: Kojo press. (ISBN-10: 8192756793, ISBN-13: 978-8192756790)
5. Agrawal, R.L. 1996. Seed Technology, Oxford & IBH Publishing Co., New Delhi.

6. Bhaskaran, M. A. Bharathi, K. Vanangamudi, N. Natarajan, P. Natesan, R. Jerlin and K. Prabakar. 2003. Principles of seed production. Kaisher Graphics, Coimbatore.
7. Copeland LO & McDonald MB. 2001. Principles of Seed Science and Technology. 4th Ed. Chapman & Hall.
8. Singhal NC. 2003. Hybrid Seed Production in Field Crops. Kalyani Publishers, New Delhi.
9. Vanangamudi, K. 2014. Seed Science and Technology. An Illustrated Text Book. New India Publishing Agency, New Delhi.
10. Kennedy, J.S and Zadda Kavitha. 2006. Manual on commercial Production of biocontrol agents. Department of Agricultural Entomology, TNAU, Coimbatore. 156p.
11. Gautam, R.D. 1994. Biological Pest Suppression. Westville Publishing House, New Delhi. 221 p

Course No.	:	SEC 003
Course Title	:	Beneficial Insect Farming
Credit Hours	:	0+2
Course Category	:	Skill Enhancement Course

Course Learning Rationale / Course Objective (CLR):

1. To enhance the skill in the apiculture, sericulture and lac culture
2. To study the mass production techniques of predators and parasitoids

Course Learning Outcomes (CLO):

1. Develop practical skills in the rearing of beneficial insects
2. Demonstrate knowledge and ability in mass production of biological control agents such as predators and parasitoids

Practical

Honey bee species, castes of bees. Beekeeping appliances and seasonal management, bee enemies and disease. Bee pasturage, bee foraging and communication. Insect pests and diseases of honey bee. Practicing and handling of honey bee colonies. Capturing techniques of wild bee colonies Beekeeping products. Mulberry cultivation, mulberry varieties and methods of harvesting and preservation of leaves. Types of silkworm, voltinism and biology of silkworm. Rearing appliances of mulberry silkworm and methods of disinfection. Rearing, mounting and harvesting of cocoons. Pest and diseases of silkworm, management. Species of lac insect, morphology, biology, host plant, lac production – seed lac, button lac, shellac, lac- products. Identification of major parasitoids and predators commonly being used in biological control. Insect orders bearing predators and parasitoids used in pest control and their mass multiplication

techniques. Important species of pollinator, weed killers and scavengers with their importance. Visit to research and training institutions devoted to beekeeping, sericulture, lac culture and natural enemies.

Practical Schedule

1. Identification, morphology and structural adaptations in honey bees
2. Different species of honey bees
3. Types of bee hive, bee keeping appliances and seasonal management
4. Rearing of queen, worker and drone cell and colony organization
5. Bee enemies and diseases
6. Apiary management tactics, bee pasturage, bee foraging and communication
7. Practicing and handling of honey bee colonies
8. Capturing techniques of wild bee colonies
9. Beekeeping products – extraction of honey bee products
10. Morphology and botanical aspects of mulberry plants
11. Mulberry cultivation - mulberry nursery bed preparation – methods of planting - pruning methods – leaf / shoot harvest– preservation of leaves
12. Pests and diseases of mulberry
13. Morphology and biology of different species of silkworm
14. Voltinism and silkworm breeds
15. Silkworm rearing requirements - rearing house and appliances
16. Disinfectants- Practicing the disinfection methods in rearing house, larval rearing and grainage
- 17. Mid Semester Examination**
18. Grainage technology
19. Methods of rearing – chawki and late age silkworm rearing
20. Mounting, harvesting and marketing of cocoon
21. Post cocoon technology and rearing techniques of non mulberry silkworm
22. Pests and diseases of mulberry silkworm
23. Lac insects, biology, host plant, strains, cultivation and their management
24. Pests of lac, extraction of lac and their products
25. Identification of different types of parasitoids
26. Identification of different types of predators
27. Mass production techniques of parasitoids
28. Mass production techniques of predators
29. Identification of weed killers, pollinators, scavengers and soil builders
30. Visit to apiculture unit
31. Visit to sericulture unit and mulberry field
32. Visit to grainage centre and silk reeling/weaving centre
33. Visit to bio control laboratory
- 34. Final Practical Examination**

Suggested Readings:

1. Dandin, S. B., J. Jayaswal and K. Giridhar. 2003. Hand book of Sericulture Technologies. Central Silk Board, Bangalore.
2. David, B. V. and V. V. Ramamurthy. 2016. Elements of Economic Entomology, Namrutha Publications, Chennai.
3. Ganga, G. and J. Sulochana Chetty. 2022. An Introduction to Sericulture. Oxford and IBH publication, New Delhi.
4. Mishra, R. C. 1995. Honeybees and their management in India. ICAR, Everest Press, New Delhi.
5. Sailesh chattopadhyay. 2011. Introduction to lac and lac culture. Birsa Agricultural University, Ranchi.
6. Singh, T. and B. Saratchandra. 2004. Principles and techniques of silkworm seed production. Discovery publishing house, New Delhi.

Course No.	:	SEC 004
Course Title	:	Drone Technology
Credit Hours	:	0+2
Course Category	:	Skill Enhancement Course

Course Learning Rationale / Course Objective (CLR):

1. To provide basic knowledge on drone components, regulations, and safe operation in agriculture.
2. To develop practical skills in flying, spraying, monitoring, maintenance, and data handling of agricultural drones.

Course Learning Outcome (CLO):

1. Students will be able to operate agricultural drones safely and effectively for spraying and monitoring.
2. Students will acquire skills in drone maintenance, minor repair, and data usage in farm applications.

Practical

Agricultural drones - Types, structure and components; DGCA regulations and safety protocols; drone parts and their functions; Standard Operating Procedures (SOP), Battery charging, Simulator, Manual flight training, Emergency handling, Mapping agricultural fields using GPS and software, Mission planning; crop monitoring - RGB, NDVI, thermal imaging; Camera calibration for crop imaging; image processing; NDVI, biotic and abiotic stress monitoring; drone spraying, Cost benefit analysis and case studies.

Practical Schedule

1. Introduction to agricultural drones: Types, structure, and components
2. DGCA regulations and safety protocols for drone operation
3. Identification of drone parts and their functions
4. Standard Operating Procedures (SOP) for safe drone handling
5. Battery care, handling, charging, and safety
6. Simulator training for basic flight skills
7. Pre-flight checklist and operational SOPs
8. Manual flight training: take-off, landing, hovering
9. Emergency handling: return-to-home, signal loss, low battery situations
10. Mapping agricultural fields using GPS and software
11. Mission planning for field spraying and data capture
12. Basics of aerial crop monitoring: RGB, NDVI, thermal imaging
13. Camera calibration and drone setup for crop imaging
14. Capturing crop images for health monitoring using drones
15. Image downloading and data transfer SOP
16. Introduction to NDVI and plant health indices
17. **Mid Semester Examination**
18. Image processing and interpretation for crop vigour and stress
19. Use of drone imagery to detect pest/disease hotspots
20. Weed and crop health mapping using RGB cameras
21. Planning site-specific spraying missions using imagery
22. Loading pesticide/fertilizer in spraying drone & calibration
23. Aerial spraying operation: demonstration
24. SOPs for drone cleaning, safety, and chemical tank maintenance
25. Troubleshooting common drone issues: software & hardware; Minor repairs: propeller, ESC, wiring, GPS, arm replacement
26. Crop stress monitoring using multispectral/thermal sensors
27. Monitoring irrigation status using aerial imagery
28. Recording and interpreting field variability using drone data
29. Cost-benefit analysis of drone operations vs conventional methods
30. Case studies: Real-world use of drones in agriculture
31. Preparation of financial project proposal
32. Visit to drone research lab or institute
33. Visit to nearby drone based company / entrepreneur / agri-tech startup
34. **Final Practical Examination**

Suggested Readings:

1. Singh, R.K. *et al.*, 2021. *Drones in Agriculture: Emerging Applications and Issues*. CRC Press.
2. Zhang and Qin, 2015. *Precision Agriculture Technology for Crop Farming*. CRC Press.
3. Fahlstrom, Paul G., Gleason and Thomas J., 2012. *Introduction to UAV Systems*. Wiley.

4. Lillesand, Thomas, Kiefer, Ralph W., and Chipman, Jonathan, 2014. *Remote Sensing and Image Interpretation*. Wiley.
5. Pix4D Tutorials: <https://support.pix4d.com>
6. DGCA India Drone Rules Portal: <https://dgca.gov.in>

Course No.	:	SEC 005
Course Title	:	Horticulture Nursery Management
Credit Hours	:	0+2
Course Category	:	Skill Enhancement Course

Course learning Rationale / Course Objective (CLR):

The purpose of learning this course is to:

- To impart hands-on skills and competencies for the scientific establishment, operation and management of horticultural nurseries with a focus on plant propagation, nursery practices, infrastructure, record keeping and entrepreneurship development.

Course Learning Outcomes (CLO):

1. Demonstrate technical knowledge of plant propagation methods used in nursery production.
2. Operate nursery tools, manage growing media and maintain propagation structures.
3. Monitor and manage irrigation, nutrition, pests and diseases in nursery plants.
4. Maintain nursery records and comply with plant certification standards.
5. Plan, budget and propose viable nursery business models and entrepreneurship projects.

Practical

Horticultural nursery management, starting with familiarization of nursery tools, layout design, and soil sterilization. It progresses to seed extraction, treatment, and sowing, as well as raising seedlings in pro-trays and polybags. Nursery raising under protected structures, identification and maintenance of mother plants, and various propagation techniques such as vegetative propagation, budding, and grafting. Nursery irrigation, fertilization, and pest management, along with record-keeping, nursery calendar preparation, and entrepreneurship planning. Visits to commercial and institutional nurseries, training in advanced techniques, and understanding quality standards and certification protocols. Market surveys, cost analysis and preparation of a nursery business model.

Practical Schedule

1. Familiarization with nursery tools, implements and containers.
2. Layout design and planning of a horticultural nursery unit.

3. Soil sterilization techniques and preparation of nursery beds.
4. Preparation and mixing of potting media using various components.
5. Seed extraction, treatment and sowing in nursery beds. Raising seedlings in pro-trays and polybags.
6. Nursery raising under protected structures (polyhouse, net house, shade net).
7. Identification and maintenance of mother plants for propagation.
8. Vegetative propagation using softwood, hardwood and semi-hardwood cuttings.
9. Practice of mound, serpentine and air layering techniques.
10. Budding techniques: T-budding, patch budding and ring budding.
11. Grafting techniques: wedge, softwood, approach and epicotyl grafting.
12. Use of plant growth regulators in propagation techniques.
13. Nursery irrigation techniques: manual, drip and sprinkler methods.
14. Fertilizer and nutrient application through fertigation in nursery conditions.
15. Identification and correction of nutrient deficiency symptoms in nursery plants.
16. Weed management techniques in containerized and bed nurseries.

17. Mid Semester Examination

18. Identification and management of common pests in nursery plants.
19. Identification and management of common diseases in nursery plants.
20. Preparation and application of biofertilizers and biopesticides.
21. Packing, labelling and transportation techniques of nursery plants.
22. Maintenance of nursery records, registers and inventory management.
23. Preparation of nursery calendar and routine work schedule.
24. Construction and maintenance of mist chambers and shade structures.
25. Media recycling and hygienic disposal of diseased materials.
26. Visit to a commercial nursery unit to study operational practices.
27. Visit to a government or institutional nursery and interaction with nursery managers.
28. Indexing and maintenance of virus-free nursery stock.
29. Training in mini-cutting techniques and care of graft union healing.
30. Identification of physiological disorders in nursery plants.
31. Management of physiological disorders in nursery plants
32. Understanding quality standards and plant certification protocols.
33. Cost analysis and budgeting of nursery establishment and operations.
- 34. Final Practical Examination.**

Course No.	:	SEC 006
Course Title	:	Mushroom Production Technology
Credit Hours	:	0+2
Course Category	:	Skill Enhancement Course

Course Learning Rationale / Course Objective (CLR):

1. To understand different types of mushrooms (edible and poisonous)
2. To acquaint with spawn production and cultivation techniques of Oyster, milky, paddy straw and button mushrooms
3. To comprehend the processing, value addition and cost of mushroom cultivation and value addition

Course Learning Outcomes (CLO):

1. Acquaint the morphology of mushroom and identification of edible and poisonous mushrooms
2. Understand oyster, milky, paddy straw and button mushrooms cropping and biotic and abiotic problems in mushroom cultivation
3. Expertise in biodegradation of agrowastes, processing, project preparation and cost analysis

Practical

Different types of mushrooms, Morphology - Edible and poisonous type - edible mushrooms-*Pleurotus*, *Agaricus*, *Volvariella* and *Calocybe* – nutritional values - and pharmacological values-preparation of culture media- pure culture techniques- sterilizing techniques-media - glassware - maintenance of culture. Mother spawn production-type of spawn - Multiplication of bed spawn – Substrates for mushroom cultivation and their preparation -mushroom cultivation techniques for *Pleurotus* and *Calocybe*- maintenance of spawn running and cropping room-harvest-packing and storage- pests, diseases and weed mould, abiotic disorders – management strategies. Substrates for mushroom cultivation and their preparation - cultivation techniques for *Agaricus* and *Volvariella*-maintenance of spawn running and cropping room-harvest-packing and storage- pests, diseases and weed mould, abiotic disorders – management strategies. Post harvest technology of *Agaricus*, *Pleurotus*, *Calocybe* and *Volvariella* – methods of preservation –Drying: solar, cabinet, fluidized bed and freeze drying – Packing methods - Controlled atmospheric storage- modified atmospheric storage and canning – Cost analysis. Biodegradation of coir pith - cost estimation- Mushroom recipes of *Agaricus*, *Pleurotus*, *Calocybe* and *Volvariella* - Cooking methods- value added products – instant food mixes –Cost analysis. Project preparation- principles of mushroom farm enterprise management – cost estimation.

Practical Schedule

1. General characters of mushrooms, edible and poisonous mushrooms and morphological characters of *Agaricus*, *Calocybe*, *Pleurotus*, *Volvariella* and

2. Equipment's, instruments and essentials for mushroom cultivation and Sterilization Techniques
3. Preparation of culture media
4. Pure culture techniques in mushroom
5. Mother spawn production techniques of oyster, milky and button mushroom: Quality of spawn, spawn contaminants and their management
6. Bed spawn production techniques of oyster, milky and button mushroom: Quality of spawn, spawn contaminants and their management
7. Visit to commercial mushroom spawn production lab
8. Oyster mushroom cultivation: Spawn running room, cropping room requirement and Substrate preparation
9. Oyster mushroom cultivation: Bed preparation, cropping, harvesting and storing
10. Oyster mushroom cultivation: Pest, disease, competitor and abiotic disorders and their management
11. Visit to commercial oyster mushroom farm
12. Milky mushroom cultivation: Spawn running room, cropping room requirement and Substrate preparation
13. Milky mushroom cultivation: Bed preparation, casing cropping, harvesting and storing
14. Milky mushroom cultivation: Pest, disease, competitor and abiotic disorders and their management
15. Visit to commercial milky mushroom farm
16. Paddy straw mushroom: Preparation of mother spawn and bed spawn
- 17. Mid Semester Examination**
18. Paddy straw mushroom: Bed preparation and cropping
19. Paddy straw mushroom cultivation: Pest, disease, competitor and abiotic disorders and their management
20. Button Mushroom cultivation: Compost Preparation
21. Button Mushroom cultivation: Spawning, Casing and Cropping
22. Button mushroom cultivation: Pest, disease, competitor and abiotic disorders and their management
23. Button mushroom cultivation: Pest, disease, competitor and abiotic disorders and their management
24. Visit to commercial button mushroom farm
25. Post Harvest Processing of mushrooms
26. Mushroom value-added products and recipes
27. Biodegradation of agrowastes using mushroom spawn: Spent mushroom – composting and their use
28. Mushroom as a component in Integrated Farming System (IFS)
29. Visit to Uzhavar sandai, markets and observing the marketing pattern of mushroom
30. Project preparation on mushroom spawn production and cost estimation
31. Project preparation on oyster mushroom production and cost estimation

32. Project preparation on milky mushroom production and cost estimation
33. Project preparation on button mushroom production and cost estimation
34. **Final Practical Examination**

Suggested Readings:

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

Web-References:

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

Course No.	:	SEC 007
Course Title	:	Post Harvest Processing Technology
Credit Hours	:	0+2
Course Category	:	Skill Enhancement Course

Course Learning Rationale / Course Objective (CLR):

The purposed of learning this course is to:

1. Gain basic knowledge on the use of various equipments and machineries in the food processing industry.
2. Understand on various properties of cereals, pulses, nuts and oil seeds and fruits and vegetables.
3. Know the process of grains, animal foods and fruits and vegetables.
4. Learn about food adulteration.

Course Learning Outcomes (CLO):

1. Provide practical knowledge on the use of appropriate processing equipments in setting up a food processing business.

2. Hands on experience in milling and oil extraction techniques of cereals, millets and pulses and oil seeds.
3. Describe the reduction techniques of anti-nutritional factors from grains.
4. Analysis and identify the food adulterants in common foods.

Practical

Study on various equipments and machineries used in food processing industry - Physical characteristics of grains - Parboiling and Milling of grains - Cooking quality of cereals - Extruded products - Unit operations for oil extraction from nuts and oil seeds - Removal of anti-nutritional factors - Properties of milk - Flavoured milk - Processing of ice cream and khoa - Grading and quality evaluation of egg - Tenderization on meat cookery - Detection of food adulteration - Mechanical drying and Osmotic dehydration of commercially important fruits and vegetables - Rehydration ratio of dehydrated foods - Refrigeration & Freezing of fruits and vegetables - Development of products from fruits and vegetables waste - Pectin extraction technique - Determination of pectin strength - Fermented fruit beverage (RTS and Squash) - Preparation of different concentration of sugar syrups - Preparation and quality evaluation of jam, jelly, marmalade, preserve, candied, crystallized and glazed fruits - Canning of fruits and vegetables - Preparation of fermented products (Sauerkraut).

Practical Schedule

1. Demonstration of various equipments and machineries used in food processing industry.
2. Physical characteristics of grains (cereals and pulses).
3. Parboiling of paddy.
4. Milling characteristics of paddy grains.
5. Cooking quality of cereals.
6. Preparation of extruded products.
7. Pulse milling.
8. Cooking quality of pulses.
9. Unit operations for oil extraction from nuts and oil seeds.
10. Removal of anti-nutritional compounds from selected pulses and oilseeds.
11. Determination of properties of milk.
12. Preparation of flavoured milk.
13. Processing of ice cream (different types) and khoa.
14. Grading and quality evaluation of egg.
15. Effect of tenderization on meat cookery.
16. Experiments on detection of food adulteration.
- 17. Mid semester examination**
18. Mechanical drying of commercially important fruits and vegetables.
19. Osmotic dehydration of fruits and vegetables.
20. Determination of rehydration ratio of dehydrated foods.
21. Preservation of food by low temperature - Refrigeration of fruits and vegetables.

22. Preservation of food by low temperature - Freezing of fruits and vegetables.
23. Development of products from fruits and vegetables waste.
24. Pectin extraction from fruit pulp and determination of pectin strength in fruit extracts.
25. Preparation and quality evaluation of non-fermented fruit beverage (RTS and Squash).
26. Preparation of different concentration of sugar syrups.
27. Preparation and quality evaluation of jam, jelly and marmalade from various fruits.
28. Preparation and quality evaluation of preserves.
29. Preparation and quality evaluation of candied, crystallized and glazed fruits.
30. Canning of fruits and vegetables.
31. Preparation of fermented products (Sauerkraut).
32. Visit to modern rice mill / grain processing units.
33. Visit to food processing/ dairy industry
34. **Final Practical Examinations**

Suggested Readings:

1. Srilakshmi, B. 2005. Food Science. New Age International (P) Ltd., Publishers, New Delhi.
2. N. Shakuntala Manay and M. Shadaksharaswamy. 2001. Foods facts and principles. New Age International (P) Limited, Publishers New Delhi.
3. Dr. Banshi D Shukia, Dr. Prabhat K Srivastava, Er. Ram K Gupta.1992. Oilseeds Processing Technology. Central Institute of Agricultural Engineering, Nabi Bagh, Berasia Road, Bhopal - 462 018, India
4. Dennis R. Heldman, University of Missouri. 1995. Food Science. Springer Science+Business Media New York.
5. Srilakshmi. B. 2015. Nutrition Science. New Age International Pvt. Ltd. New Delhi
6. Kader A A. 2002. Postharvest technology of horticultural crops. 3rd edn, University of California, Agricultural and Natural Resources.
7. Srivastava R P and Kumar Sanjeev. 2019. Fruit and Vegetable Preservation – Principles and Practices. CBS Publishers and Distributors Pvt Ltd.

Course No.	:	SEC 008
Course Title	:	Poultry Production Technology
Credit Hours	:	0+2
Course Category	:	Skill Enhancement Course

Course Learning Rationale / Course Objective (CLR):

1. To educate students about the current status of the poultry industry and the issues confronted by the poultry producers.
2. To provide opportunity for the students to learn about all aspects of the commercial broiler production.
3. To provide practical information on poultry management
4. To acquire hands on training for establishing a small-scale commercial poultry enterprise that open avenues for self employment.

Course Learning Outcome (CLO):

1. The students gain knowledge in basic concepts of scientific rearing of poultry.
2. Imparts fundamental knowledge on poultry farming with current trends in the industry.
3. Develop hands-on-skills in poultry farm operations such as brooding, litter management, feeding, vaccination and Disease control
4. Provides exposure and train students in entrepreneurial aspects of poultry farming

Practical

Introduction – Poultry Industry in India - Selection of farm site and poultry strains- Systems of rearing and housing – construction of poultry house - cleaning and disinfection of poultry house and equipment- poultry farm equipment- Preparation of brooder house – Brooding- Litter management- Feeding management- Feed ingredients - Disease management and Vaccination schedule – Summer management - Technical standards - Farm records - Integration- Poultry farm Economics - Dressing of chicken -- Visit to poultry farms / Institutions / sales outlets

Practical Schedule

1. Poultry Industry in India.
2. Selection of farm site.
3. Selection of chicks.
4. Systems of poultry rearing.
5. Housing for poultry.
6. Cleaning and disinfection of poultry house and equipments.
7. Identification of poultry farm equipment.
8. Preparation of brooder house to receive the chicks.
9. Management at the time of arrival of chicks
10. Brooding of chicks.

11. Litter management.
12. Types of feeds
13. Feed formulations
14. Feeding management
15. Identification of poultry feed ingredients.
16. Disease management
17. **Mid Semester Examination**
18. Vaccination of birds.
19. Summer management of birds.
20. Technical standards in commercial poultry production.
21. Measures of efficiency in poultry production.
22. Poultry farm integration.
23. Rodent and pest management
24. Maintenance of farm records.
25. Demonstration of dressing of chicken.
26. Sale of chicken, billing and accounting
27. Economics of poultry production
28. Customer care and keeping up the business relations
29. Problems faced during rearing and sales
30. Farm visit I
31. Institution visit
32. Visit to butcher shop / retail shop
33. Feedback by students
34. **Final Practical Examination**

Suggested Readings:

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

Course No.	:	SEC 009
Course Title	:	Seed Production Technology
Credit Hours	:	0+2
Course Category	:	Skill Enhancement Course

Practical

Scope and importance of seed industry and seed production - Cereals, pulses, oilseeds, cotton and commercially important vegetable crops-principles and practices of seed production - Generation system of seed multiplication - Pollination behaviour - Tools employed in hybrid seed production - Designing of Planting ratio and Border rows - Physical and genetic contaminants – isolation distance. Planning of seed production - season and land selection - Assessment of seed source and seed selection - pre sowing seed invigouration treatments - Dormancy breaking treatments - Seed priming - pelleting - polymer coating. Practicing nursery and main field preparation - Practicing the sowing of seeds in the nursery – pro-tray nursery - management. Main field preparation - layout - formation of beds - transplanting - fertilizer and nutrient management - weed management - irrigation management - special cultural practices – pest and disease management - identification and removal of off-types and volunteer plants -Practicing hybridization techniques (emasculation and pollination and detasseling) - Identification of physiological disorders and management - Exposure visit to seed certification department - Seed certification procedures - Registration and sowing report - Field inspection – Field counting – Seed yield assessment-Visit to seed production plots. Pre-harvest sanitation spray - identification of physiological and harvestable maturity indices - Harvesting methods - Post harvest verification - Kapas sorting, cob sorting and pod verification - Threshing / extraction of seeds - Processing sequence - Seed drying - Seed cleaning - Grading - Pre-storage seed treatment - Seed packing - Seed storage -Visit to seed processing unit and seed storage godown and learning sanitation measures. Economics of variety and hybrid seed production (cost benefit ratio) - Visit to private seed industry. Seed sampling procedure and submission of samples - Seed testing procedure - Estimation of seed moisture - Physical purity analysis - Germination test - Visit to grow out test field and DNA finger printing laboratory for genetic purity assessment - Visit to seed retail shop - Seed marketing - Project preparation.

Practical Schedule

1. Scope and importance of seed industry and seed production - Cereals, pulses, oilseeds, cotton and commercially important vegetable crops.
2. Principles and practices of seed production.
3. Generation system of seed multiplication.
4. Pollination behaviour - tools employed in hybrid seed production.
5. Designing of planting ratio and border rows - Physical and genetic contaminants - Isolation distance.
6. Planning of seed production - season and land selection - assessment of seed source and seed selection.
7. Pre sowing seed invigouration treatments - Dormancy breaking treatments - Seed priming - pelleting - polymer coating.
8. Practicing nursery preparation - Practicing sowing of seeds in the nursery - pro-tray nursery management.

9. Main field preparation - layout - formation of beds – transplanting.
10. Fertilizer and nutrient management.
11. Weed and Irrigation management.
12. Special cultural practices – Practicing hybridization techniques (Emasculation and pollination and detasseling).
13. Pest and disease management.
14. Identification and removal of off-types and volunteer plants.
15. Identification of physiological disorders and management.
16. Exposure visit to seed certification department and Visit to seed production plots - Seed certification procedures - Registration and sowing report - Field inspection - Field counting - Seed yield assessment-.
- 17. Mid Semester Examination**
18. Pre-harvest sanitation spray - Identification of physiological and harvestable maturity indices - harvesting methods.
19. Post-harvest verification - Kapas sorting, cob sorting and pod verification.
20. Threshing / extraction of seeds.
21. Seed Drying – principles, moisture equilibrium – Types of drying - Seed driers - types.
22. Seed processing - principle - importance - seed cleaning, grading and upgrading – equipments.
23. Visit to seed processing unit.
24. Seed sampling procedure and submission of samples.
25. Seed testing - Estimation of seed moisture.
26. Seed testing - Physical purity analysis.
27. Seed testing - Germination test.
28. Visit to grow out test field and DNA finger printing laboratory for genetic purity assessment.
29. Pre-storage seed treatment and Seed packing.
30. Seed storage - principles - factors affecting seed longevity during storage - Seed storage godown and learning sanitation measures.
31. Economics of variety and hybrid seed production (cost benefit ratio) and Seed Production Planning.
32. Visit to private seed industry
33. Visit to retail seed shop - Seed marketing. Project preparation
- 34. Final Practical Examination**

Suggested Readings:

1. Agrawal, R.L. 2019. Seed Technology. Oxford & IBH Publishing Company Pvt. Ltd., New Delhi.
2. Hebblethwaite, P. D. 1980. Seed Production. Butterworth Heinemann Ltd., London, UK.
3. Joshi, A. K. and Singh, B. D. 2004. Seed Science and Technology. Kalyani Publishers, New Delhi.

4. Kulkarni, G. N. 2011. Principles of Seed Technology. Kalyani Publishers, New Delhi.
5. McDonald, M.B. and Copeland, L. 1998. Seed Production Principles and Practices. CBS Publishers, New Delhi.
6. Mondal, S.S., Saha, M. and Sengupta, K. 2009. Seed Production of Field Crops. New India 1326 Publishing Agency, New Delhi.
7. Sen, S. and Ghosh, N. 2010. Seed Science and Technology. Kalyani Publishers, New Delhi.
8. Singhal, N. C. 2010. Seed Science and Technology. Kalyani Publishers, New Delhi.

Course No.	:	SEC 010
Course Title	:	Soil, Plant and Water Testing
Credit Hours	:	0+2
Course Category	:	Skill Enhancement Course

Course Learning Rationale/ Course objective (CLR):

The purpose of learning this course is;

1. To impart the knowledge of Soil, Plant and Water testing to the students.

Course Learning Outcomes (CLO):

After the completion of this course, the student

1. will have the skill of testing the different parameters of soil, plant and water.
2. will be specialist in rapid test of plant tissue

Practical

Standardization of solutions and reagents, collection and preparation of soil samples, estimation of soil physical and chemical properties – Soil densities, texture, pH, EC, organic carbon, macro and micronutrients, CEC and exchangeable cations in soil. Fertilizer calculation and recommendation. Plant sampling and sample preparation for analysis, digestion of plant material and estimation of macro and micro nutrients in plant. Rapid plant tissue test for N, P and K. Water sampling - Determination of EC, pH, cations (Ca, Mg, Na, K) and anions (CO₃, HCO₃, Cl, SO₄) in irrigation water and computation of salt and classification of water sample as per different methods.

Practical Schedule

- 1,2. Principles of analytical chemistry: Analytical techniques, concepts of gravimetry, concepts of titrimetry (volumetric). Instruments used in soil, plant, water, analysis: pH meter, EC meter, Spectrophotometer, Flame photometer, Atomic Absorption, Spectrophotometer (AAS).

- 3,4. Standardization of solutions and reagents. Collection and preparation of soil, plant and water samples.
- 5,6. Determination of soil bulk density, particle density and porosity. Determination of soil texture by feel method and hydrometer method.
- 7,8. Estimation of pH and EC in soil and saturation paste extract. Determination of CEC and exchangeable cations in soil.
- 9,10. Estimation of cations and anions in saturation paste extract.
- 11,12. Determination of organic carbon and available nitrogen in soil.
- 13,14. Determination of available phosphorus, potassium and sulphur in soil.
- 15,16. Determination of available DTPA extractable Zn, Fe, Mn and Cu and hot water-soluble boron in soil.

17. Mid Semester Examination

- 18,19. Estimation of lime and gypsum requirement of a problem soil.
- 20,21. Fertilizer recommendation – calculations. Estimation of nitrogen content in plant.
- 22,23. Estimation of phosphorus, potassium, calcium, magnesium and sulphur nutrient content in plant.
- 24,25. Estimation of micronutrients content in plant. Rapid plant tissue test for N, P and K
- 26,27. Determination of pH, EC, Ca and Mg in irrigation water
- 28,29. Determination of Na, K, CO_3 and HCO_3 in irrigation water.
- 30,31. Determination of Cl , SO_4 and boron in irrigation water.
- 32,33. Classification of irrigation water using different approaches. Computation of salt in water sample.

34. Final Practical Examination

Suggested Readings:

- 1. M.L. Jackson 1973. Soil Chemical Analysis, Prentice Hall of India Pvt. Ltd., New Delhi.
- 2. H.L.S. Tandon 1990. Methods of Analysis of soil, plant, water and fertilizers, FDCO, New Delhi.
- 3. P. K. Gupta 1999-2000. Soil, Plant, Water and Fertilizer Analysis, AgroBotanica, Bikaner
- 4. Richards, L.A. (1954). Diagnosis and improvement of saline and alkali soils. USDA Hand book No. 60, Washington, DC USA.
- 5. Black, C.A. 1965. Agronomy Monograph. Methods of Soil Analysis. Part 1. Physical and Mineralogical properties including Statistics of Measurement and Sampling. Wiley, New York.
- 6. Hesse, P.R. 1971. A Text book of Soil Chemical Analysis. John Murray (Publishers) Ltd. London
- 7. Motsara, M.R and R.N. Roy.2008. Guide to laboratory establishment for plant nutrient analysis. Food and Agriculture organization of the United Nations.Rome.pp.220 (also available online)
- 8. Piper, C.S 1942. Soil and plant analysis: Inter science Publishers, New York.

Course No.	:	SEC 011
Course Title	:	Surveying and Leveling
Credit hours	:	0+2
Course category	:	Skill Enhancement Course

Course Learning Rationale/Course Objective (CLR):

1. To develop practical skills in measuring distances, angles, and elevations using chain and dumpy level for basic surveying tasks.
2. To train students in conducting field surveys such as chain surveying, compass surveying, and leveling for preparation of plans and profiles.
3. To enhance accuracy and interpretation skills in recording, reducing, and plotting survey data manually.

Course Learning Outcomes (CLO):

1. Apply skills in using basic surveying instruments and analyze data.
2. Apply skills to conduct traverse survey and to find the area
3. Apply the knowledge of levelling in different operations in civil engineering projects.
4. Summarize the principles and purpose of basic levelling in surveying.
5. Use total station in the field of civil engineering land survey

Practical

Introduction- Surveying instruments; chains, tapes, cross staff and their types and its uses. Chain Surveying- Ranging and Chaining of Survey lines. Field work and Plotting of Chain survey Compass Surveying- Prismatic Compass & Surveyor compass Uses, Bearings, Local attraction, Fieldwork & Plotting. Levelling- General principle. Types of levels and their temporary and permanent adjustments. Methods of levelling. Reduction of levels. Total station-general commands used- instrument preparation and setting-reading distances and angles, Measurement of distances and coordinates of given points, using Total station, Measurement of altitudes of given elevated points, using total station.

Practical Schedule

1. Study of survey instruments – Folding and unfolding the chain – Roles of Leader and Follower
2. Methods of chaining on level ground – Methods of chaining on sloping ground
3. Procedure for entering records in the field book
4. Study of conventional symbols used in surveying
5. Direct and indirect measurement in surveying using a chain
6. Chain and cross-staff surveying – Linear measurements – Plotting and calculating areas
7. Area computation using the Mid Ordinate Method
8. Area computation using the Average Ordinate Method
9. Area computation using Simpson's Rule

10. Area computation using the Trapezoidal Rule
11. Area computation using the co-ordinate method
12. Volume computation using the Trapezoidal Rule
13. Volume computation using the Prismoidal Rule
14. Study of compass surveying – Temporary adjustment of a prismatic compass
15. Compass surveying – Bearing observation and angle computation
16. Compass surveying – Measurement of included angles
17. **Mid Semester Examination**
18. Compass surveying – local attractions of bearing
19. Study of plane table surveying – Accessories and procedure for setting up a plane table at a station
20. Plane table surveying using the Radiation Method
21. Plane table surveying using the Intersection Method
22. Plane table surveying using the Traversing Method
23. Study of leveling instruments – adjustments of a dumpy level
24. Study of Simple and differential leveling
25. Determination of elevation difference using a dumpy level – Rise and Fall Method
26. Determination of elevation difference using a dumpy level – Height of Collimation Method
27. Preparation of a contour map
28. Measurement of farm pond volume
29. Area measurement using GPS
30. Total Station – Operation, setting up, and taking measurements
31. Preparation of a college survey map using chain and dumpy level
32. Pre leveling of paddy field through dumpy level
33. Field visit to a project site
34. **Final Practical Examination**

Suggested Readings:

1. Surveying and Levelling N.N. Basak. Mcgraw hill publications
2. A Textbook of Surveying and Levelling, R. Agor, Standard Book House.
3. Surveying: Theory and Practice by James M. Anderson, Edward M. Mikhail, Tata McGraw Hill.

Course No.	:	SEC 012
Course Title	:	Vermicompost production technology
Credit Hours	:	0+2
Course category	:	Skill Enhancement Course

Course learning Rationale/ Course Objectives (CLR):

1. To impart hands-on-experience training in vermicompost production technologies
2. To train the students for establishing the vermicompost production unit, certification procedures and marketing

Course Learning Outcome (CLO):

1. Acquiring knowledge and skill in establishment of vermicompost unit
2. Understanding the vermicompost production technologies
3. Gaining knowledge on organic input certification procedures and marketing

Practical

Visit to vermicompost unit; Earth worm - selection, biology, Selection of suitable site and establishment of vermicompost unit; Preparation of organic waste; Vermicomposting – Process, post harvest handling; Physico-chemical properties assessment, certification and marketing of vermicompost.

Practical schedule

1. Importance of organic waste management
2. Vermicomposting – Definition, concept, history and environmental advantages
3. Visit to vermi compost production unit
4. Role of earthworms in decomposition and nutrient recycling
5. Market potential of vermicompost and scope for rural employment,
6. Government initiatives and policies for scaling up vermicompost production unit
7. Classification of earthworms and selection of suitable species for composting
8. Ideal environmental conditions, biology and production cycle of earth worms
9. Procurement and maintenance of earthworms
10. Common predators of earthworms and their management
11. Study on types and suitability of biodegradable waste required for vermicomposting
12. Study on green and brown materials balance, moisture content and CN ratio of feed stock
13. Acquiring skill in Sourcing and storage and pre-treatment of organic waste
14. Physico-chemical analysis of feedstock
15. Acquiring skill in site selection for vermicompost unit
16. Study on required tools and equipment for vermicomposting

17. Mid Semester Examination

18. Acquiring skill in planning of lay out construction of vermicompost unit
19. Acquiring skill in cost estimation and budgeting of vermicomposting
20. Acquiring skill in layering of vermibed and inoculation of earthworms
21. Acquiring skill in maintenance of safety and hygiene measures in vermicompost unit
22. Acquiring skill in monitoring the decomposition stages and assessing the compost maturity
23. Acquiring skill in monitoring the decomposition stages and assessing the compost maturity
24. Acquiring skill in documentation of production process of vermicompost
25. Acquiring skill in separation of worms from matured compost
26. Acquiring skill in manual and mechanical harvesting of vermicompost
27. Acquiring skill in cleaning and reusing compost beds
28. Estimating the yield of vermicompost
29. Acquiring skill in post-harvest handling, labelling and branding vermicompost
30. Study on value added and by-products of vermicompost
31. Physico-chemical analysis of vermicompost and vermiwash
32. Carrying out organic input certification procedures
33. Acquiring skill in marketing of vermicompost and earthworms

34. Final Practical Examination**Suggested Readings:**

1. Sathe, T.V. Vermiculture and Organic Farming. Days Publishing House, New Delhi.
2. Vaishali Badwaik, 2025. Textbook on vermiculture and vermicomposting, Bhumi Publishing, India.
3. Yashwant B.Patne. Textbook on vermiculture and vermicomposting, Prabhakar Publication, India.
4. Sohan Singh Walia and Tarmanpreet Kaur, 2024. Earthworms and vermicomposting-Species, Procedures and Application, Springer Nature.

Course No.	:	SEC 013
Course Title	:	Video Production
Credit Hours	:	0+2
Course category	:	Skill Enhancement Course

Course learning Rationale/ Course Objectives (CLR):

To impart skill in video production to the students by providing hands on experience through exposing technologies.

Course Learning Outcome (CLO):

1. Skill in handling video camera and shooting videos
2. Skill in editing the audio and video using softwares
3. Practice in script writing
4. Skill in application of Open Board Casting Software

Practical Schedule

1. Exposure visit to video production centre / Educational Media Centre to understand different types of camera and camera support system
2. Familiarisation of video camera, parts of video camera and other accessories. Handling of camera support system
3. Basic handling of video camera
4. Practicing video camera with white balance
5. Practicing, Composition, Focusing, Zooming and Shooting
6. Practicing different camera positions- long shot, medium shot, close up, zoom, tilting and panning
7. Lighting techniques and moods
8. Familiarising with drone camera and its parts
9. Exposure on Drone Technology Centres to study its operation
10. Different types of video scripts – basic production script, story board script, camera script
11. Planning script for five minutes video programme
12. Script for documentary production and drama – story board
13. Care and maintenance of camera
14. Exposure on audio recording equipments
15. Exposure on Audio editing softwares
16. Practicing - Installing of video and audio software into desktop computer
- 17. Midsemester examination**
18. Sound – audio recording, voice dubbing and audio mixing
19. Familiarizing of open source softwares for video & audio editing
20. Video editing using smart phones
21. Synchronising the audio in video editing smart phones
22. Familiarising in exporting final output in mobile
23. Creating videos using images and text, designing of video titles using adobe photoshop
24. Familiarising voice recording techniques using smart phones
25. Advance techniques of exporting final video for different formats and sizes
26. Video editing techniques – video libraries and graphic libraries
27. Video and audio online and offline editing
28. Non-linear programme editing& Methods of off line video editing
29. Advanced techniques of - cut – mix - editing
30. Using Graphics and animation in video production

31. Application of open-source software – Gimp, Blender
32. Applications of Open Board Casting Software (OBS), Google sketchup
33. Presentation of produced program
- 34. Final Practical Examination**

Suggested readings:

1. Jim Owens and Gerald Millerson.2008. Video Production Handbook, Focal Press, USA.
2. Wallace Jackson. 2015. "Android Studio New Media Fundamentals: Content Production of Digital Audio/Video, Illustration and 3D Animation" Apress, USA.
3. News Editing - Bruce II. Westley
4. Radio and TV Journalism- Jan R Hakemulder, PP Singh, Fay AC DE Jonge
5. Radio and TV Journalism – K.M. Srivastava

Course No.	:	SEC 101
Course Title	:	Apiculture
Credit Hours	:	0+2
Course Category	:	Skill Enhancement Course

Course Learning Rationale / Course Objective (CLR):

The purpose of learning this course is:

1. To enhance the skill on honey bee rearing
2. To know about the seasonal management of honey bees
3. To study the capturing and rearing techniques in stingless bee
4. To know about the extraction and processing of honey bee products

Course Learning Outcomes (CLO):

1. Acquire practical skills in honey bee colony establishment and maintenance
2. Understand and apply seasonal management practices for honey bee colonies
3. Understand rearing techniques specific to stingless bees
4. Demonstrate techniques for the extraction, processing and handling of bee products

Practical

Identification, morphology and structural adaptations in honey bees. Different species of honey bees. Bee keeping appliances and types of bee hive. Rearing of queen, worker, drone cell and colony organization and queen rearing techniques. Establishment of apiary unit -Seasonal management of honey bee colonies. General apiary management practices. Practicing and handling of honey bee colonies- Indian bees and Italian bees.

Bee behaviour -Bee pasturage, foraging and communication. Bee enemies and diseases and their management. Bee keeping products - Extraction of bee products - Processing and storage of honey. Honey bee nutrition - Evaluation of artificial food supplements. Honey bee as bioindicator. Migratory beekeeping. Biology, colony organization of stingless bee - Different types of hive for domestication - Capturing and rearing technique -Extraction of honey from stingless bee. Quality control of honey bee products. Case studies of beekeeping in crops. Marketing -Value addition of bee products and medicinal properties. Capturing technique of wild bee colonies. Visit to apiculture unit, honey processing unit and quality control unit.

Practical Schedule

1. Identification, morphology and structural adaptations in honey bees.
2. Different species of honey bees
3. Bee keeping appliances
4. Types of bee hives
5. Rearing of queen, worker, drone cell and colony organization
6. Queen rearing techniques and artificial queen bee insemination
7. Establishment of apiary unit
8. Seasonal management of honey bee colonies - Summer
9. Seasonal management of honey bee colonies - Monsoon and winter
10. General apiary management practices
11. Practicing and handling of honey bee colonies- Indian bees
12. Practicing and handling of honey bee colonies- Italian bees
13. Bee behaviour - bee pasturage
14. Bee behaviour - bee foraging and bee communication
15. Bee enemies and their management
16. Bee diseases and their management
- 17. Mid Semester Examination**
18. Bee keeping products - extraction of bee products
19. Processing and storage of honey
20. Honey bee nutrition and evaluation of artificial food supplements
21. Honey bee as bioindicator
22. Migratory beekeeping
23. Biology, colony organization of stingless bee
24. Different types of hive for domestication of stingless bee
25. Capturing and rearing technique of stingless bee
26. Extraction of honey from stingless bee
27. Quality control of honey bee products
28. Case studies of beekeeping in crops
29. Marketing of honey bee products
30. Value addition of bee products and medicinal properties
31. Capturing technique of wild bee colonies
32. Visit to apiculture unit

33. Visit to honey processing unit and quality control unit

34. Final Practical Examination

Suggested Readings:

1. Abrol, D. P. 2019. Beekeeping- A compressive guide to bees and beekeeping. Scientific Publishers, India.
2. David, B. V. and V. V. Ramamurthy. 2016. Elements of Economic Entomology, Namrutha Publications, Chennai.
3. Mishra, R. C. 1995. Honeybees and their management in India. ICAR, Everest Press, New Delhi.

Course No.	:	SEC 102
Course Title	:	Computer Programming and Data Structures
Credit Hours	:	0+2
Course Category	:	Skill Enhancement Course

Course Learning Rationale / Course Objective (CLR):

The purpose of learning this course is to: understand fundamental data structures, algorithm design and analysis, applying data structures to solve problems, developing programming skills, learn about searching and sorting techniques.

Course Learning Outcomes (CLO):

Ability to analyze algorithms, skill in selecting appropriate data structures, proficiency in implementing data structures, improved problem solving skills, understanding of abstract data types, familiarity with searching and sorting algorithms, ability to design and implement solutions using data structures.

Practical

Introduction To High Level Languages; Structure Programming, C Programming, A Simple C Programming, Execution Of A 'C' Program, Program And Instruction; Familiarizing With C Ide Code: Blocks; Building An Executable Version Of C Program; Study Of Different Operators Such As Arithmetic, Relational, Logical, Assignment, Increment And Decrement, Conditional, Bitwise And Special Operators, Precedence Of Arithmetic Operators; Debugging A C Program; Developing And Executing Simple Programs; Creating Programs Using Decision Making Statements Such As If, Go To And Switch; Developing Program Using Loop Statements While, Do And For; Using Nested Control Structures; Familiarizing With One And Two Dimensional Arrays; Using String Functions; Creating User Defined Functions; Developing Structures And Union; Using Local, Global And External Variables; Using Pointers; Developing Linked Lists In C Language; Inserting An Item In Linked List; Deleting An Item In Linked List; Implementing Stacks; Implementing Push/Pop Functions; Creating Queues, Insertion/Deletion In Queues.

Practical Schedule

1. Introduction to high level languages;
2. Structure programming,
3. C programming, a simple c programming, execution of a 'c' program, program and instruction; familiarizing with c ide code::blocks; building an executable version of c program;
4. Study of different operators such as arithmetic, relational,
5. Logical, assignment,
6. Increment and decrement,
7. Conditional,
8. Bitwise and special operators,
9. Precedence of arithmetic operators;
10. Debugging a c program;
11. Developing and executing simple programs;
12. Creating programs using decision making statements such as if,
13. Go to
14. Switch;
15. Developing program using loop statements while, do
16. For
- 17. Mid semester examination**
18. Using nested control structures;
19. Familiarizing with one and two dimensional arrays;
20. Using string functions;
21. Creating user defined functions;
22. Developing structures and union;
23. Using local, global and external variables;
24. Using pointers;
25. Developing linked lists in c language;
26. Inserting an item in linked list;
27. Deleting an item in linked list;
28. Implementing stacks;
29. Implementing push functions;
30. Implementing pop functions;
31. Creating queues,
32. Insertion in queues
33. Deletion in queues
- 34. Final Practical Examination**

Suggested Readings:

1. Subrat Kumar Mahapatra, Prasannajit Mishra and Jayashankar Pradhan. Introductory Agri-Informatics, Third Edition, Jain Brothers, 2024

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

Course No.	:	SEC 103
Course Title	:	Farm Machinery
Credit Hours	:	0+2
Course Category	:	Skill Enhancement Course

Course Learning Rationale / Course Objective (CLR):

1. To familiarize students with various makes, models, and functional systems of agricultural tractors.
2. To provide practical skills in conducting pre-operational checks and routine maintenance of tractors.
3. To train students in the safe operation and driving of tractors and power tillers under field conditions.
4. To develop the ability to hitch, de-hitch, and adjust primary and secondary tillage implements.
5. To enable students to understand and perform various ploughing methods and field pattern operations.
6. To provide hands-on experience in the calibration and operation of seed drills and sprayers.

Course Learning Outcomes (CLO):

1. Identify various makes and models of tractors and understand their functional systems.
2. Perform pre-start maintenance checks and follow safety procedures.
3. Operate tractors and adjust both primary and secondary tillage implements.
4. Hitch and de-hitch mounted and trailed implements effectively.
5. Drive tractors with trollies in forward and reverse directions safely.
6. Operate and calibrate different types of sprayers.

Practical

Familiarization with different makes and models of agricultural tractors. Identification of various functional systems including air supply, fuel, cooling,

transmission, steering and hydraulic systems. Maintenance points to be checked before starting a tractor. Familiarization with controls on a tractor. Safety rules and precautions to be observed while driving a tractor. Practice of driving a tractor and with tillage tools (Primary/Secondary tillage implements) and their adjustment in the field. Field patterns while operating a tillage implement. Hitching and de-hitching of mounted and trailed type implements to the tractor. Practice for driving of a trailed type of trolley: forward and in reverse direction. Familiarization with different types of sprayers. Operation of tractor operated boom and orchard sprayers. Calibration of a sprayer. Nozzle spacing on a boom, pressure setting of a nozzle. Use of Pick Positioner. Use of drones for spraying. Familiarization with tractor operated tree pruners.

Practical Schedule

1. Familiarization with different makes and models of agricultural tractors.
2. Study of air supply and fuel systems in tractors.
3. Study of cooling system components and their maintenance.
4. Understanding the transmission and steering systems in tractors.
5. Introduction to the hydraulic systems used in tractors.
6. Performing maintenance checks before starting a tractor.
7. Hands-on training with tractor controls and dashboard functions.
8. Safety rules and precautions for operating a tractor.
9. Practical session on basic forward driving of a tractor in the field.
10. Practice of driving in both forward and reverse directions.
11. Introduction to primary tillage implements – types and applications.
12. Introduction to secondary tillage implements – functions and adjustments.
13. Demonstration of different methods of ploughing.
14. Adjusting tillage implements according to field conditions.
15. Practice on field patterns during tillage operations.
16. Training on hitching and de-hitching mounted implements.
- 17. Mid Semester Examination**
18. Hitching and field adjustment of the Mouldboard (MB) plough.
19. Hitching and field adjustment of the Disc plough.
20. Field operation and hitching of secondary tillage implements – harrows and cultivators.
21. Hitching and adjustment of rotavator in the field.
22. Study of seed drills – calibration, hitching, and field adjustments.
23. Driving practice with a power tiller.
24. Study and operation of intercultural equipment – dry land, wet land, and power weeders.
25. Demonstration field clearance equipments
26. Practical session on attaching and detaching trailed implements.
27. Driving practice with a trailed trolley in the forward direction.
28. Driving a tractor with a trolley in reverse – steering and maneuvering techniques.

29. Overview of different types of agricultural sprayers.
30. Identification of components and operation of power sprayers.
31. Introduction to sprayer calibration – principles and procedures.
32. Practical calibration of a sprayer using water and measurement tools.
33. Field demonstration of drone-based spraying and data collection.

34. Final Practical Examination

Suggested Readings:

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

Course No.	:	SEC 104
Course Title	:	Installation, Operation and Maintenance of Micro Irrigation Systems
Credit Hours	:	0+2
Course Category	:	Skill Enhancement Course

Course Learning Rationale / Course Objective (CLR):

1. To impart hands-on training on the design, installation, and maintenance of micro irrigation systems.
2. To familiarize students with different components of drip and sprinkler systems.
3. To develop skills in the operation, fertigation, chemigation, automation, and troubleshooting in micro irrigation.
4. To equip students to analyze water quality, soil moisture, crop water needs, and uniformity of water application.
5. To introduce IoT and automation techniques in modern irrigation practices.

Course Learning Outcomes (CLO):

1. Identify and install various components of micro irrigation systems (drip and sprinkler).
2. Operate and maintain micro irrigation and fertigation systems effectively.
3. Evaluate the performance and uniformity of irrigation systems.
4. Implement automated irrigation using sensors, solenoid valves, and timing devices.
5. Estimate the cost economics and perform field visits to assess real-time installations.

Practical

Micro irrigation system installation: installation of filters and fertigation equipment; installation of main and sub mains; Laying of laterals, Punching of laterals, and fixing the emitters, operation of micro irrigation system; Maintenance of micro irrigation system; Filter cleaning, maintenance of fertigation equipment, chemical treatment, sub main and lateral bi-wall flushing, Introduction to automated irrigation system in open field and green houses – sensors for soil moisture, temperature, light control devices, timing devices, fertigation system, solenoid devices, remote controlled valve system

Practical Schedule

1. Introduction to micro irrigation and its scope
2. Fundamentals of fluid mechanics and their application in micro irrigation
3. Acquaintance with different components of a micro irrigation system
4. Installation of micro irrigation system (Both drip and sprinkler) – main, submain, lateral and emitters, riser and sprinkler head
5. Water quality analysis for drip irrigation system
6. Operation of the micro irrigation system
7. Determination of pump requirement and selection
8. Design of a drip irrigation system in the field
9. Hydraulics of drip irrigation system
10. Computation of crop water requirement
11. Installation and operation of fertigation equipment
12. Study and maintenance of different filters (screen, sand, disc, etc.)
13. Maintenance of micro irrigation system
14. Chemigation treatment in drip irrigation system
15. Design of sprinkler irrigation system
16. Hydraulics of sprinkler irrigation system
- 17. Mid Semester Examination**
18. Determination of uniformity coefficient of drip irrigation system
19. Determination of uniformity coefficient of sprinkler irrigation system
20. Performance evaluation of installed micro irrigation system
21. In-situ measurement of soil moisture using sensors
22. Determination of hydraulic conductivity of soil
23. Determination of wetting pattern in drip irrigation system
24. Measurement of soil moisture using tensiometer
25. Determination of soil moisture characteristic curve
26. Determination of upward flux using tensiometer
27. Study of components of an automated irrigation system
28. Operation of automated micro irrigation systems in open fields and greenhouses
29. IoT-based irrigation system operation: solenoid valve and timing device setup
30. Different methods of automation in irrigation systems

31. Cost economics of micro irrigation system
32. Visit to a micro irrigation system in a farmer's field or institutional farm
33. Visit to an automated irrigation system in a greenhouse (or industry exposure)
34. **Final Practical Examination**

Suggested Readings:

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

Course No.	:	SEC 105
Course Title	:	Introduction to Forestry
Credit Hours	:	0+2
Course Category	:	Skill Enhancement Course

Course Learning Rationale / Course Objective (CLR):

The purpose of learning this course is to:

1. Impart practical knowledge on identification, propagation and management of farm-grown trees.
2. Develop skills related to nursery practices, measurement techniques and forestry-based industries.
3. Familiarize students with wood and non-wood forest products and their commercial applications.

Course Learning Outcomes (CLO):

1. Identify major farm-grown tree species, seeds and seedlings.
2. Select suitable nursery sites and perform layout and propagation techniques.
3. Apply methods for measuring height, diameter and estimating volume of standing trees.
4. Recognize wood and non-wood forest products.
5. Understand the processing and marketing aspects of forestry-based industries.
6. Visit and analyze agroforestry plantations and related industries for hands-on exposure.

Practical

Identification of important farm grown trees, tree seeds and seedlings. Site selection for tree nursery and layout of nursery. Propagation methods, plantation establishment, plantation management, pest and diseases management and harvesting for various wood-based industries. Height measurement, diameter measurement and Volume estimation in trees - Identification of wood and non - wood forest products - Visit to Agroforestry plantations. Visit to Pulp and Paper, Matchwood, Energy, plywood industries to study the production, processing and marketing.

Practical Schedule

1. Introduction to forestry tools and safety procedures in field practices.
2. Identification of important farm-grown tree species common to Tamil Nadu (e.g., *Melia dubia*, *Ailanthus excelsa*, *Casuarina equisetifolia*, *Tectona grandis*).
3. Identification of tree seeds: morphology, dormancy, viability tests.
4. Identification of seedlings in early nursery stages: monocots vs. dicots, morphology.
5. Criteria for selecting a suitable nursery site: soil, water, slope, proximity.
6. Layout and planning of nursery beds, mist chambers and shade nets.
7. Seed propagation techniques: pre-treatment, sowing, watering, germination care.
8. Asexual propagation: budding, grafting, air layering and stem cuttings.
9. Nursery practices for commonly grown multipurpose trees in agroforestry systems.
10. Techniques of plantation establishment: site preparation, spacing, pit digging.
11. Irrigation methods in forestry nurseries and plantations: basin, drip and furrow methods.
12. Practices in plantation management: thinning, pruning, weeding, mulching.
13. Identification and diagnosis of common insect pests and diseases in forest trees.
14. Integrated Pest Management (IPM) in tree plantations: biological and chemical controls.
15. Methods of harvesting trees for different uses: saw-timber, pulp, poles, biomass.
16. Measurement of tree height by shadow method and single pole method.
- 17. Mid Semester Examination**
18. Measurement of tree height using hypsometer.
19. Diameter measurement using calipers and diameter tapes.
20. Volume estimation of standing trees using volume tables and formulas, and felled trees by sectional method.
21. Identification of wood forest products: teak, rosewood, sandalwood, eucalyptus, acacia.
22. Visit to local timber depots to observe grading, seasoning and auction procedures.
23. Identification of non-wood forest products (NWFPs): gums, resins, honey and medicinal plants.

24. Study of collection, processing and packaging of NWFPs.
25. Visit to Agroforestry Research Station – demonstration of species trials and intercropping systems.
26. Visit to State Forest Nursery – practical exposure to large-scale nursery operations.
27. Visit to TNPL (Tamil Nadu Newsprint and Papers Limited), Karur – paper production from wood and agro-residues.
28. Visit to Plywood/Matchwood Industry at Sivakasi – understanding wood processing and grading.
29. Visit to Casuarina Energy Plantation (Delta region) – energy plantation management and economics.
30. Visit to FC&RI, Mettupalayam
31. Analysis of marketing channels for timber and NWFPs – mandis, FPCs, cooperatives.
32. Data collection from plantation visits and exercises in record-keeping.
33. Compilation of nursery and plantation logs – sample record formats for forest department.
34. **Final Practical Examination**

Suggested Readings:

1. Chundawat, D.S. & Gautam, S.K. (2017). Textbook of Agroforestry. Oxford and IBH Publishing.
2. Tiwari, K.M. (1992). Social Forestry. APH Publishing Corporation, New Delhi.
3. Dhiman, R.C. (2010). Forestry Principles and Applications. Kalyani Publishers.
4. Dwivedi, A.P. (2003). Forest Management. International Book Distributing Co., Lucknow.
5. Tewari, D.N. (2008). A Monograph on Non-Wood Forest Products of India. International Book Distributors.

Course No.	:	SEC 106
Course Title	:	Landscape Gardening
Credit Hours	:	0+2
Course Category	:	Skill Enhancement Course

Course Learning Rationale / Course Objective (CLR):

1. To explain the fundamental principles and elements of landscape design, including balance, proportion and unity, and how to apply these concepts in creating aesthetic and functional landscapes.

2. To identify various ornamental plants, trees, shrubs, and ground covers, and select the most appropriate species based on climate, soil, and aesthetic needs.
3. To design and plan the layout of gardens, including hardscape features like pathways, walls, and water bodies, ensuring a harmonious and sustainable landscape.
4. To maintain different landscape features, including proper irrigation, pruning, fertilization, pest control, and seasonal adjustments for plants and garden structures.

Course Learning Outcomes (CLO):

1. Identify and classify various ornamental plants, trees, shrubs, and ground covers used in landscape gardening.
2. Demonstrate the ability to design basic landscape plans for home gardens, public parks, and institutional spaces using principles of design and aesthetics.
3. Gain practical skills in site preparation, planting techniques, and maintenance of different landscape features such as lawns, hedges, borders, and water bodies.
4. Select appropriate landscaping styles (formal, informal, modern, etc.) based on location, climate, and intended function.

Practical

Identification and use of garden tools and equipment. Study of growth characters, identification and classification of ornamental trees, shrubs, climbers, ground covers and indoor plants. Making and maintenance of edge, hedge and topiary. Establishment and maintenance of a lawn. Bonsai making. Art principles of landscaping. Formal and informal gardens. Planning, designing and establishment of garden features. Landscape design process: Landscape drafting tools. Dimensioning, graphic symbols and notations. Site analysis and landscape designing of residential, public buildings and religious places.

Practical Schedule

1. Study of garden tools and equipment's used in landscape architecture.
2. Study of graphic language and use of drawing equipments in Landscape architecture
3. Study of graphic symbols and notations used in landscape designing.
4. Identification and classification of avenue trees.
5. Identification and classification of shrubs.
6. Identification and classification of annuals.
7. Identification and classification of pot plants.
8. Identification and classification of climbers and ground covers
9. Study of various features of an ornamental garden with suitable plants and identification of plants for each feature.
10. Study and designing of different styles of gardens, Study and designing of gardens based on different themes.
11. Study of making and maintenance of edges.
12. Study of making and maintenance of hedges and topiary.

13. Art of trophy and carpet beds.
14. Identification of indoor plants and their maintenance.
15. Identification of outdoor plants and their maintenance.
16. Identification of lawn grasses.

17. Mid Semester Examination

18. Methods of establishment of lawn grasses.
19. Maintenance of lawn grasses.
20. Practices on horticultural crafts – bonsai.
21. Practices on horticultural crafts terrarium
22. Practices on flower arrangements.
23. Practices on horticultural crafts Vegetable and fruit carving.
24. Identification of different living components - their form, size, shape, texture flowering and their beauty and utility in the garden.
25. Identification of different non- living components - their form, size, shape, texture flowering and their beauty and utility in the garden.
26. Study about site analysis and preparation of bubble graph.
27. Principles of landscape drawing and fundamentals of manual drawing. Preparation and practices on manual drawing and budget preparation.
28. Fundamentals of designing garden – Plan view, elevation and perspective diagram.
29. Computer aided landscape designing.
30. Preparation of landscape plan for residential, bungalow, Institute and Industry gardens.
31. Preparation of landscape plan for public buildings and religious places.
32. Preparation of landscape plan for roads and roundabouts.
33. Visit to community parks and Institutional gardens.

34. Final Practical Examination.

Suggested Readings:

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

Course No.	:	SEC 107
Course Title	:	Nursery Production in Horticulture crops
Credit Hours	:	0+2
Course Category	:	Skill Enhancement Course

Course Learning Rationale / Course Objective (CLR):

1. Understand the basic principles and significance of nursery production in horticulture.
2. Acquire skills in the selection and preparation of nursery sites and materials.
3. Develop proficiency in propagation techniques (sexual and asexual) for horticultural crops.
4. Learn nursery management practices including irrigation, fertilization, pest/disease control, and hardening.
5. Gain experience in marketing and economic evaluation of nursery enterprises.

Course Learning Outcomes (CLO):

1. Identify suitable sites and design layout plans for horticultural nurseries.
2. Propagate horticultural plants using appropriate techniques (seed, grafting, budding, layering, etc.).
3. Manage nursery activities effectively including media preparation, potting, and transplanting.
4. Diagnose and manage nursery pests and diseases using IPM practices.
5. Prepare and evaluate a small-scale nursery business plan with basic cost-benefit analysis.

Practical

Layout of model nursery, Tools and equipment-identification and application. Different methods of breaking seed dormancy stratification, scarification and use of plant growth regulators. Extraction and storage of healthy seeds, seed bed preparation, Identification and raising of rootstocks for different fruit plants, soil solarization, preparation of potting mixtures. Selection of healthy scion wood, practices in different methods of plant propagation like cutting, layering, budding and grafting in fruit plants. Micropropagation-explant preparation, media preparation, culturing—meristem tip culture, axillary bud culture, micro-grafting and hardening of plants. Nursery management practices i.e. weed control, irrigation, nutrition, removal of sprouts etc. Protection of nursery plants against adverse climatic conditions. Protected structures. Diagnosis and control of important diseases and pests in the nursery, lifting and packing of nursery plants, Visit to commercial tissue culture laboratories and accredited nurseries.

Practical Schedule

1. Introduction to nursery production: scope, importance, and types.
2. Selection and layout planning of a nursery site.
3. Identification and use of nursery tools, equipment, and materials.
4. Soil sterilization techniques: solarization, steam, and chemical treatments.

5. Preparation of nursery beds: flat, raised, and sunken beds.
6. Preparation and sterilization of potting media (soil, sand, compost, cocopeat, etc.).
7. Seed treatment and sowing techniques for horticultural crops.
8. Germination testing and seedling assessment.
9. Pricking and transplanting of seedlings.
10. Preparation and use of nursery containers: polybags, trays, pots.
11. Propagation by cuttings: softwood, semi-hardwood, and hardwood.
12. Preparation and application of rooting hormones.
13. Budding techniques: T-budding and patch budding.
14. Grafting methods: wedge, whip, cleft, and approach grafting.
15. Layering methods: simple, mound, serpentine, and air layering.
16. Collection and preparation of scion and rootstock materials.

17. Mid Semester Examination

18. Micropropagation: explant selection and sterilization.
19. Micropropagation: preparation of tissue culture media (Murashige and Skoog).
20. Identification of nursery pests and beneficial insects.
21. Nursery pest management: biological, chemical, and cultural approaches.
22. Diagnosis and management of nursery diseases.
23. Weed management practices in nurseries.
24. Irrigation systems: hand watering, drip, and sprinkler methods.
25. Nutrient management: composting and fertilizer application.
26. Hardening and acclimatization of nursery seedlings. Potting and repotting of nursery plants.
27. Labelling, tagging, and record-keeping in nursery operations.
28. Packaging and transportation of nursery plants.
29. Nursery layout design: drawing and interpretation.
30. Educational visit to a commercial or government nursery.
31. Project planning: establishment of a small model nursery unit.
32. Economic analysis: cost estimation, pricing, and profitability.
33. Preparation of a nursery business or entrepreneurship plan.

34. Final Practical Examination.

Suggested Readings:

1. Chaitanya, K. (2021). Orchard Management. In *Recent Advances in Sapota Production and Post-Harvest Management* (pp. 117–126). New Delhi Publishers.
2. Bose, T.K., Mitra, S.K., & Sadhu, M.K. (1991). Propagation of Tropical and Subtropical Horticultural Crops. In *Propagation of Horticultural Plants* (pp. 1–250). Naya Prokash.

Course No.	:	SEC 108
Course Title	:	Orchard Floor Management
Credit Hours	:	0+2
Course Category	:	Skill Enhancement Course

Course Learning Rationale / Course Objective (CLR):

The purpose of learning this course is to:

1. To provide knowledge on layout of different systems of orchards and fruit nutrition garden
2. To provide knowledge on soil management practices in orchard
3. To provide knowledge on layout of various irrigation systems
4. To provide knowledge on application of manure and fertilizers and use of organic manures in orchard

Course Learning Outcomes (CLO):

1. Explain the different systems of orchards and fruit nutrition garden
2. Analysis the soil management practices in orchard
3. Learn about the various irrigation systems in orchard
4. Narrate application of manure and fertilizers and use of organic manures in orchard

Practical

Layout of different systems of orchards and Fruit Nutrition Garden. Soil management practices: clean cultivation, sod culture, sod mulch, intercropping, cover cropping and mixed cropping. Use of mulch materials: organic and inorganic, moisture conservation and weed control. Layout of various irrigation systems, surface irrigation: Flood system, basin system, modified basin system, furrow method, sub-surface irrigation systems: drip irrigation and its components, overhead irrigation: sprinkler system, fertigation, Different methods of application of manure and fertilizers, use of organic manures, Biofertilizers, Green manuring and bio-agents. Visit to orchards of Progressive fruit growers.

Practical Schedule

1. Planning and layout of different systems of orchards
2. Planning and layout of fruit nutrition garden
3. Planting and lay out of different planting systems of orchard
4. Records maintenance in orchard
5. Studies on clean cultivation in orchard
6. Studies on sod culture in orchard
7. Studies on sod mulch in orchard
8. Studies on intercropping in orchard
9. Studies on cover cropping in orchard

10. Studies on mixed cropping in orchard
11. Study of organic mulches in orchard
12. Study of inorganic mulches in orchard
13. Soil management in relation to soil organisms
14. Nutrient uptake
15. Study of moisture conservation methods and observations on soil moisture contents under mulches
16. Observations on weed growth under different systems of management
- 17. Mid Semester Examination**
18. Weed management in orchard
19. Use of different weedicides in orchard
20. Layout, components and use of flood system of irrigation in the orchard
21. Layout, components and use of basin system of irrigation in the orchard
22. Layout, components and use of modified basin system of irrigation in the orchard
23. Layout, components and use of furrow method of irrigation in orchard
24. Layout, components and use of drip system of irrigation in orchard
25. Layout, components and use of modified basin system of irrigation the orchard
26. Layout, components and use of sprinkler system of irrigation in orchard
27. Layout, components and use of fertigation system in orchard
28. Different methods of application of manure and fertilizers in orchard
29. Classification and application of organic manures in orchard
30. Classification and application of biofertilizers in orchard
31. Use of green manures in orchard
32. Use of bio-agents in orchard
33. Visit to orchards of progressive fruit growers
- 34. Final Practical Examination**

Suggested Readings:

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

7. Mazumdar. B.C. 2004. Orchard Irrigation and Soil Management Practices. Daya Publishing Agency, New Delhi. Daya Publishing Agency, New Delhi.

Course No.	:	SEC 109
Course Title	:	Packing and Packaging of Horticultural Crops
Credit Hours	:	0+2
Course Category	:	Skill Enhancement Course

Course Learning Rationale / Course Objective (CLR):

The purposed of learning this course is to:

1. Understand basic knowledge of different packaging materials and their properties for horticultural produce.
2. Gain knowledge on different type of damages occurring in horticultural crops.
3. Understand the modern packaging techniques for horticultural produce.

Course Learning Outcomes (CLO):

1. Provide practical knowledge on selecting and using appropriate packaging materials for horticultural crops during transportation and storage.
2. Describe the different type of damages occurring to horticultural crops and their management.
3. Provide ability to use appropriate modern packaging techniques for shelflife improvement of horticultural crops.

Practical

Different packaging and cushioning materials used for horticultural produce. Packaging technology for retail marketing- vacuum, shrink-wrap, cling pack. Concept of active and passive packaging. Important physical parameters of different packaging materials. Determination of gas permeability and water vapour permeability of packaging materials. Designing of retail packaging boxes. Different type of damages occurring in horticultural crops during transportation. Packaging technology for domestic and export of commercial horticultural crops. Controlled and modified atmospheric packaging for shelf-life enhancement. Visit to commercial pack house. Visit to fruits and vegetables market.

Practical Schedule

1. Studies on different packaging and cushioning materials used for fruits.
2. Studies on different packaging and cushioning materials used for vegetables.
3. Studies on different packaging and cushioning materials used for roots and tuber crops.
4. Vacuum packaging technology for fruits and vegetables.

5. Shrink wrapping techniques for fruits and vegetables.
6. Cling packing techniques for fruits and vegetables.
7. Active and passive packaging technologies for fruits and vegetables.
8. Studies on important physical parameters of different packaging materials.
9. Determination of gas permeability of packaging materials.
10. Determination of water vapour permeability of packaging materials.
11. Studies on designing of retail packaging boxes.
12. Different types of damages occurring in fruits during transportation.
13. Different types of damage occurring in vegetables during transportation.
14. Different types of damage occurring in roots and tuber crops during transportation
15. Pre-packaging techniques for fruits.
16. Pre-packaging techniques for vegetables.

17. Mid Semester Examination

18. Pre-packaging techniques for roots and tuber crops.
19. Edible waxing of fruits.
20. Edible waxing of vegetables
21. Edible waxing of root and tuber crops.
22. Bottling of fruits and vegetables.
23. Canning of fruits and vegetables.
24. Minimal processing of fruits and vegetables.
25. Consumer and transport packaging for fruits and vegetables.
26. Controlled atmospheric packaging of fruits for shelf life extension.
27. Controlled atmospheric packaging of vegetables for shelf life extension.
28. Controlled atmospheric packaging of roots and tuber crops for shelf life extension
29. Modified atmospheric packaging of fruits for shelf life extension.
30. Modified atmospheric packaging of vegetables for shelf life extension.
31. Modified atmospheric packaging of root and tuber crops for shelf life extension.
32. Visit to commercial pack house.
33. Visit to fruits and vegetable market.

34. Final Practical Examination

Suggested Readings:

1. Battacharjee, S. K. and De, L. C. 2005. Post Harvest Technology of Flowers and Ornamentals Plants. Ponteer Publisher, Jaipur, India.
2. Saraswathy, S. et. al. 2008. Post harvest Management of Horticultural Crops. Agribios (India).
3. Mitra, S. K. 1997. Post Harvest Physiology and Storage of Tropical and Sub-tropical Fruits. CAB International.
4. Verma, L. R. and Joshi, V. K. 2000. Post Harvest Technology of Fruits and Vegetables. Vol. I & II. Indus Publishing Co., New Delhi.
5. Postharvest Management and Value Addition of Fruits and Vegetables by Kureel M.K. Biotech, 181p.

Course No.	:	SEC 110
Course Title	:	Post-Harvest Management of Horticulture Produce
Credit Hours	:	0+2
Course Category	:	Skill Enhancement Course

Course Learning Rationale / Course Objective (CLR):

The purposed of learning this course is to:

1. Understand basic knowledge of different pre-harvest and post-harvest factors, maturity and harvesting techniques of fruits and vegetables.
2. Basic knowledge on layout of postharvest experiments and packhouse and different packaging of horticultural crops.
3. Know the importance about cold chain management in horticulture produces.
4. Gain knowledge on commercial techniques for processing of fruits and vegetables.

Course Learning Outcomes (CLO):

1. Provide practical knowledge on various methods for determining maturity of fruits and vegetables.
2. Describe about postharvest treatments for shelflife extension of horticultural produce.
3. Hands on experience on various packaging technology of fruits and vegetables.
4. Provide skill on postharvest loss reduction through processing of fruits and vegetables.

Practical

Layout and planning of postharvest experiments, Maturity and harvesting of horticulture produce. Judging maturity by different methods. Harvesting tools. Objective measurement of colour, texture and dry matter. Components and equipment used in Postharvest laboratory, Different types of cleaning agents and washing methods for horticultural produce. Layout of packhouse and General Packhouse operation. Sorting, surface sanitizing and drying of fruit. Postharvest treatments for shelflife extension of fruits and vegetables. Packing of fruits in different packaging materials, preparation of different coating materials and their method of applications. Pre-cooling of horticultural produce. Ripening technology for horticultural crops. Significance of sorting and grading in horticulture produce: Types of grading system and standards. Cold-chain management. Storage requirements. Commercial technologies for processing of horticultural produce.

Practical Schedule

1. Determining maturity stages of commercially important fruits.
2. Determining maturity stages of commercially important vegetables.
3. Studies on harvesting techniques in horticultural crops.
4. Determining quality (colour, texture and dry matter) of fruits and vegetables by objective methods.

5. Studies on important equipments used in post-harvest technology laboratory.
6. Studies on different types of cleaning agents and washing methods for horticultural produce.
7. Layout of packhouse and general packhouse operation.
8. Studies on importance of sorting, grading, washing, surface sanitizing and drying of fruits and vegetables.
9. Studies on different postharvest treatments for shelf life extension of fruits and vegetables.
10. Studies on different packaging materials and methods for horticultural crops.
11. Edible waxing of fruits and vegetables.
12. Studies on different pre-cooling methods of horticultural produces.
13. Ripening management in fruits.
14. Studies of different grading system and standards for fruits and vegetables.
15. Cold chain management of horticultural crops.
16. Studies on storability of fruits and vegetables

17. Mid Semester Examination

18. Studies on storability of tuber and bulb crops.
19. Studies on packaging and storage of flowers.
20. Studies on vase life extension of cut flowers.
21. Studies on 'on-farm' storage structures for fruits and vegetables.
22. Estimation of PLW during storage of fruits and vegetables
23. Studies on biochemical changes during storage of fruits and vegetables.
24. Preparation and quality evaluation of RTS.
25. Preparation and quality evaluation of squash.
26. Preparation and quality evaluation of jam and jelly.
27. Preparation and quality evaluation of candy and preserve.
28. Preparation and quality evaluation of sauce/ Ketchup and chutney.
29. Dehydration of fruits - Sapota, Mango, Banana, Papaya and Grapes.
30. Dehydration of vegetables - Brinjal, Tomato, Cluster bean, Bitter gourd and Bhendi.
31. Minimal processing of fruits and vegetables.
32. Visit to cold storage / grading and packing unit
33. Visit to fruits and vegetables processing industry.

34. Final Practical Examinations

Suggested Readings:

1. Post-harvest technology of horticultural crops by S.K. Sharma and M.C Nautiyal.
2. Postharvest Management and Value Addition by Aswini Kumar Goel, Rajender Kumar and Satwinder S. Mann. Daya Publishing House.
3. Postharvest Management and Value Addition of Fruits and Vegetables by Kureel M.K. Biotech,181p.
4. Verma, L. R. and Joshi, V. K. 2000. Post Harvest Technology of Fruits and Vegetables. Vol. I & II. Indus Publishing Co., New Delhi.

5. Chadha, K. L. and Kalloo, G. 1993. Advances in Horticulture. Vol. 4 to 10. MPH, New Delhi. Hulme, A.C. 1970. Food Science & Technology - A Series of Monograph. The Biochemistry of Fruits and their Products. Vol.-1. Academic Press London & New York.
6. Saraswathy, S. et. al. 2008. Post harvest Management of Horticultural Crops. Agribios (India).

Course No.	:	SEC 111
Course Title	:	Seed Production Techniques in Vegetable Crops
Credit Hours	:	0+2
Course Category	:	Skill Enhancement Course

Practical

Vegetable seed industry in India, Floral biology, pollination and breeding behaviour of important vegetable crops, Categories of seeds and their maintenance, Characteristics of quality seed, Agronomical principles and methods of seed production in important vegetable crops, Use of growth regulators and chemicals in vegetable seed production, Methods of hybrid seed production, Seed harvesting, extraction, curing, drying, grading, packaging and storage, Seed sampling and seed testing (genetic purity, seed viability, seedling vigour, germination, physical purity), Visit to seed processing units, seed testing laboratory and seed production farms.

Practical Schedule

1. Scope and importance of Vegetable of seed industry in India.
2. Studying floral biology, pollination and breeding behaviour of solanaceous and malvaceous vegetable crops.
3. Studying floral biology, pollination and breeding behaviour of cucurbitaceous and leguminous vegetable crops.
4. Categories of seeds and their maintenance - Characteristics of quality seed.
5. Agronomic principles of seed production in vegetable crops.
6. Tools employed in hybrid seed production in vegetable crops.
7. Designing of planting ratio and border rows - Physical and genetic contaminants - Isolation distance.
8. Planning of seed production - season and land selection - assessment of seed source and seed selection.
9. Pre-sowing seed invigouration treatments - Dormancy breaking treatments
10. Seed quality enhancement techniques - priming - pelleting - polymer coating.
11. Practicing nursery preparation - Practicing sowing of seeds in the nursery - protray nursery.
12. Main field preparation - layout - formation of beds – transplanting.
13. Use of growth regulators and chemicals in vegetable seed production.

14. Fertilizer and nutrient management.
15. Weed management and Irrigation management.
16. Special cultural practices and practicing hybridization techniques (Emasculation and pollination).

17. Mid Semester Examination

18. Identification and removal of off-types and volunteer plants.
19. Pest and disease management.
20. Identification of physiological disorders and management.
21. Identification of physiological and harvestable maturity indices - harvesting methods.
22. Post-harvest verification.
23. Threshing / extraction of seeds - Practicing wet and dry seed extraction methods - curing.
24. Seed Drying – principles, moisture equilibrium – Types of drying- Seed driers-types.
25. Seed processing - principle - importance - seed cleaning, grading and upgrading – equipments.
26. Seed sampling procedure and submission of samples.
27. Seed testing procedure (genetic and physical purity).
28. Seed testing procedure (seed viability, seedling vigour and germination).
29. Seed treatment and packaging materials - measures for pest and disease control during storage and godown sanitation.
30. Seed storage - principles - factors affecting seed longevity during storage.
31. Visit to seed production farms.
32. Visit to seed processing plant.
33. Visit to seed testing laboratory.

34. Final Practical Examination

Suggested Readings:

1. George, R.A.T.1985. Vegetable Seed Production. Lonhman Inc., New York.
2. Hazra P and Som M G. 2009. Vegetable seed production and Hybrid Technology. Kalyani Publishers, Ludhiana.
3. Kulkarni, G. N. 2011. Principles of Seed Technology. Kalyani Publishers, New Delhi.
4. Ram HH, Upadhyay R, Dubey R K and Mandal B C. 2017. Vegetable seed production, Principles and practices. Kalyani Publishers, Ludhiana.
5. Singh, S P. 2001. Seed production of commercial vegetables. Agrotech Publishing, Udaipur.
6. Vanangamudi, K., Natarajan, N., Srimathi, P., Natarajan, K., Saravanan, T., Bhaskaran, M., Bharathi, A., Natesan, P. and Malarkodi, K. 2006. Advances in Seed Science and 1330 Technology. Vol. 2. Quality Seed Production in Vegetables. Agro bios, Jodhpur.

Course No.	:	SEC 112
Course Title	:	Sericulture
Credit Hours	:	0+2
Course Category	:	Skill Enhancement Course

Practical

Morphology and botanical aspects of mulberry plant - mulberry varieties - Mulberry nursery and their management - Main field preparation - Identification of weeds in mulberry and their management - Nutritional deficiency in mulberry - Pruning, harvesting and preservation of mulberry leaves - Pests and diseases of mulberry and their management - Morphology and biology of mulberry silkworm - Voltinism and silkworm breeds - Rearing house and their appliances - Disinfectant - Grainage technology - Methods of Rearing - chawki silkworm and late age silkworm - Pests and diseases of mulberry silkworm and their management - Mounting, harvesting and marketing of cocoon - Post-cocoon technology - Mechanization in sericulture – Morphology, biology and rearing techniques of eri silkworm - tasar silkworm - muga silkworm - Mulberry byproducts, Silkworm byproducts and practicing cocoon craft - Visit to mulberry nursery and main field - Chawki and late age silkworm rearing unit - Grainage centre - Cocoon market and reeling/weaving unit - Quality control and silk mark organisation.

Practical Schedule

1. Morphology and botanical aspects of mulberry plant
2. Special features of mulberry varieties
3. Practicing the propagation of mulberry plants
4. Mulberry nursery and their management
5. Main field preparation for establishment of mulberry garden
6. Identification of weeds in mulberry and their management
7. Identification of Nutritional deficiency in mulberry and their management
8. Pruning, harvesting and preservation of mulberry leaves
9. Pests of mulberry and their management
10. Diseases of mulberry and their management
11. Morphology and biology of mulberry silkworm
12. Voltinism and silkworm breeds
13. Rearing house and their appliances
14. Disinfectant and practicing the disinfection methods in rearing house, larval rearing and grainage
15. Grainage technology
16. Methods of rearing – chawki silkworm
- 17. Mid Semester Examination**
18. Methods of rearing – late age silkworm
19. Pests of mulberry silkworm and their management
20. Diseases of mulberry silkworm and their management

21. Mounting, harvesting and marketing of cocoon
22. Post-cocoon technology
23. Mechanization in sericulture
24. Morphology and biology of eri silkworm
25. Rearing techniques of eri silkworm
26. Morphology, biology and rearing techniques of tasar silkworm
27. Morphology, biology and rearing techniques of muga silkworm
28. Mulberry byproducts, silkworm byproducts and practicing cocoon craft
29. Visit to mulberry nursery and main field
30. Visit to chawki and late age silkworm rearing unit
31. Visit to grainage centre
32. Visit to cocoon market and reeling/weaving unit
33. Visit to quality control and silk mark organisation
- 34. Final Practical Examination**

Suggested Readings:

1. Dandin, S. B., J. Jayaswal and K. Giridhar. 2003. Hand book of Sericulture Technologies. Central Silk Board, Bangalore.
2. FAO. 1987. Manual on Sericulture, FAO Agricultural Services Bulletin, Rome.
3. Ganga, G. and J. Sulochana Chetty. 2022. An Introduction to Sericulture. Oxford and IBH publication, New Delhi.
4. Narasimhanna, M. N. 1988. Manual on Silkworm Egg Production. Central Silk Board, Bangalore.
5. Singh, T. and B. Saratchandra. 2004. Principles and techniques of silkworm seed production. Discovery publishing house, New Delhi.

Course No	:	SEC 113
Course Title	:	Turf and Turf Management
Credit Hours	:	0+2
Course Category	:	Skill Enhancement Course

Course Learning Rationale / Course Objective (CLR):

The purpose of learning this course is to:

1. To impart hands on training on practical aspects of turf management practices.
2. To impart entrepreneurial skills in turf establishment.
3. To provide knowledge on the classification, characteristics and ecological requirements of major turf grass species used in different climatic regions.

4. To acquaint with the principles and practices of turf grass establishment, including site preparation, seeding, sodding and sprigging techniques.

Course Learning Outcomes (CLO):

The students will be able to

1. Prepare a turf establishment project and to execute the same.
2. Manage turf in commercial units.
3. Understand the taxonomy, growth habits, and ecological requirements of various turf grass species suited to different landscapes and climates.
4. Demonstrate the ability to plan and implement turf grass establishment methods including site preparation, selection of species, and planting techniques.
5. Apply scientific principles and techniques for turf maintenance such as mowing, irrigation scheduling, fertilization, aeration, and pest management.

Practical

Site analysis for turf establishment. Field preparation and layout for turf making. Identification and classification of turf grasses. Turf establishment methods. Sod production. Turf irrigation management. Nutrient management in turf grasses. Special practices in turf management. Rejuvenation of old and withered turf. Equipment for turf management. Selection and maintenance of grasses for Golf course and Cricket ground. Turfing for roof top gardens. Applications and use of Turf growth regulators (TGRs). Identification of seasonal turf grass weeds. Integrated approaches for turf weed management. Identification and management of Turf grass diseases, insect-pests, abiotic stress disorders and nutrient deficiencies.

Practical Schedule

1. Site selection for turf establishment
2. Site analysis for turf establishment
3. Field preparation
4. Lay out for turf making
5. Classification of turf grass
6. Identification of turf grass
7. Turf establishment methods – I
8. Turf establishment methods – I
9. Sod production
10. Equipment for turfing and Propagation of turf grasses.
11. Irrigation methods
12. Irrigation management
13. Layout of drainage systems.
14. Nutrient management in turf grasses
15. Special practices in turf management – I
16. Special practices in turf management – II

17. Mid Semester Examination

18. Rejuvenation of old and withered turf
19. Equipment for turf management
20. Selection and maintenance of grasses for Golf course
21. Selection and maintenance of grasses for cricket ground
22. Turfing for roof top gardens
23. Applications and use of Turf growth regulators (TGRs)
24. Identification of seasonal turf grass weeds
25. Renovation of lawns
26. Integrated approaches for turf weed management – I
27. Integrated approaches for turf weed management – II
28. Identification and management of Turf grass diseases
29. Identification and management of insect-pests
30. Abiotic stress disorders
31. Nutrient deficiencies and remedial measures
32. Astrourfing practices
33. Visit to Botanical Garden, model cricket ground, Govt. organizations
- 34. Final Practical Examination**
