# Maa Shakumbhari University, Saharanpur

Undergraduate Course for Curriculum & Syllabus

B.Sc. Agriculture (Hons.)

{4 Year (8 Semester) Degree Course}

Based on

NEP 2020

&

*ICAR VI$^{th}$ Dean's Committee Recommendation*

## Faculty of Agriculture

# 1. Restructuring of Undergraduate Programmes

**Restructuring of UG Programs**

The restructuring has been done based on the following -

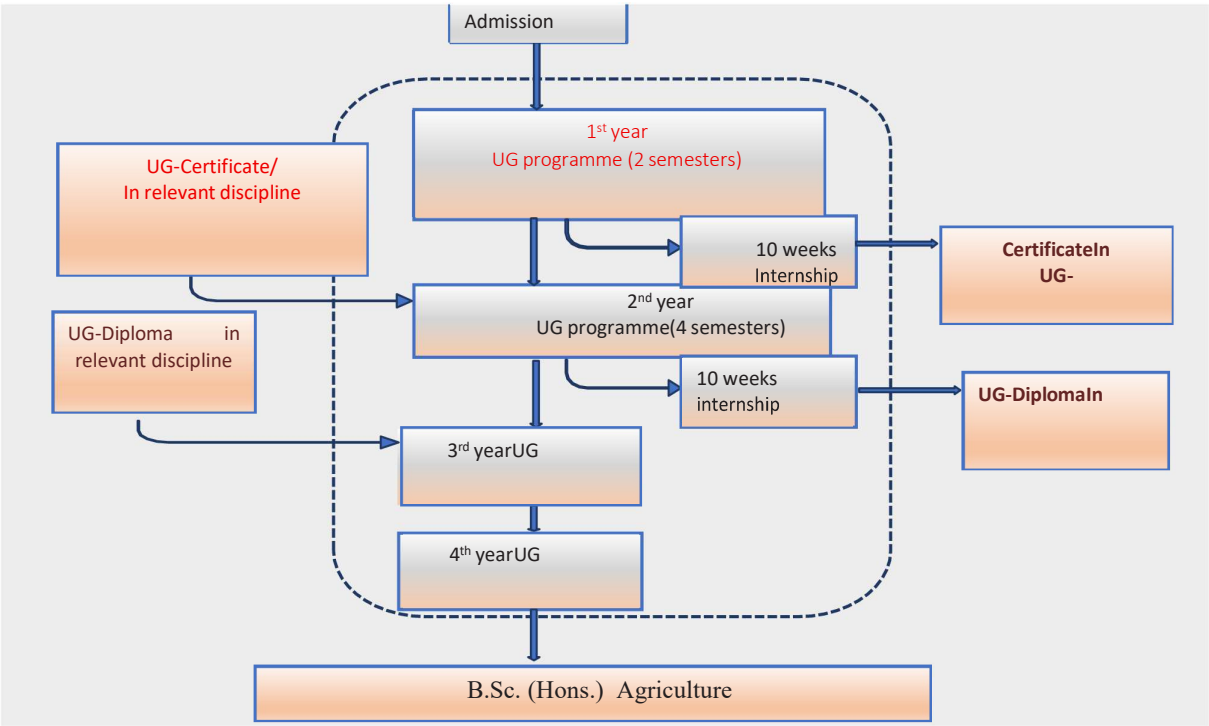
Year 1, Certificate Course.

Year-2, Diploma Course.

Year 4, B.Sc. (Hons.) Agriculture

The restructured program for the undergraduate agriculture educationwith multiple entry and exit options are illustrated in Figure 1.1.

**Fig. 1.1 Framework of Undergraduate Programmes**




The eligibility for entry into the UG programs will be Intermediate/10+2 with the Science (PCM/PCB) & Agriculture; the students will be admitted as per norms of ICAR/ SAUs/CAUs/SGUs and SRC. The 1st year of the programme will be having the foundation, introductory and skillenhancement courses. The 2nd year will be having basic core courses with some more options for skill enhancement. The 3rd year of the programme will have advanced core courses. The 4th year programme will emphasize more on the specialization and elective courses as well as advanced skill enhancement through internship.

There will be exit options after 1st year and 2nd year for UG-Certificate and UG-Diploma. However, the students opting to exit with UG-Certificate or UG-Diploma will have to take up 10 weeks internship after the 1st year (2 semester) and 2nd year (4 semesters), respectively.

Table 1.1 shows the restructured undergraduate programs for the higher agricultural educational institutions (HAEIs).

**Table 1.1 Types of courses and learning outcomes for the restructured under graduate programs for the HAEIs**

| Year | Types of courses | Learning outcome | Exit option |
|---|---|---|---|
| YEAR 1 | Foundation courses, introductory courses and skills enhancement training/training in the chosen area, ability enhancement courses | Students will acquire the basic knowledge in respective disciplines and adequate skill in some selected areas, to enable them for employment/ entrepreneurship | A student must complete 10 weeks of internship (10 credits) after 1st year if exit with UG-Certificate is opted |
| YEAR-2 | Basic core courses and additional skill enhancement in chosen areas/ courses | Students will acquire the higher-level knowledge in respective disciplines and adequate skill in some selected areas, to enable them for employment at middle level / supervisory level or for entrepreneurship | A student must complete 10 weeks of internship (10 credits) after 2nd year if exit with UG-Diploma is opted |
| YEAR-3 | Advanced core subjects and their practical applications | Students will have deeper understanding of the subjects and their major application areas | No exit after 3rd year |
| YEAR-4 | Specialization/ Elective courses and advanced skill enhancement through project and internship | Students will acquire advanced knowledge and skill in different areas so as to meet the higher order requirements of the society and industry as well as other prospective employers. It will also enable the graduates to become a job provider rather than being a job seeker through establishment of enterprises in concerned fields. | UG degree in concerned discipline |

**Credit Hours Allocation**

A total of 193 credit hours is recommended for the four years of B. Sc Ag (Hons.) programs. The credit distributions for the different courses have been specified for individual disciplines. The general structure is given in Table 1.2.

**Table 1.2 General Credits Allocation Scheme of UG Programs (Credit hours)**

| Semester | Core Courses (Major+ Minor) | Multi-Disciplinary Course (MDC) | Value Added Course (VAC) | Ability Enhancement Course (AEC) | Skill Enhancement Course (SEC) | Internship/ Project/ Student READY | Total Credits | Non-Gradial | Online Courses/ MOOC |
|---|---|---|---|---|---|---|---|---|---|
| I | 15 | 3(2) | - | 1(3) + 2(4) | 4 | - | 25 | 2(1)+1(14) | 10 |
| II | 11 | - | 3(6) | 1(3) + 2(7) | 4 | - | 21 | - | |
| Post-II semester | | | | | | 10(12) | | | |
| III | 16 | 3(5) | - | 2(8) | 2 | - | 23 | - | |
| IV | 19 | - | 3 (10) | ---- | 2 | - | 24 | - | |
| Post-IV semester | | | | | | 10(13) | | | |
| V | 19 | 3(9) | - | - | - | - | 22 | - | |
| VI | 23 | - | - | - | - | - | 23 | 2(11) | |
| VII | 20 | - | - | - | - | - | 20 | - | |
| VIII | - | - | - | - | - | 20 | 20 | - | |
| Total | 123 | 9 | 6 | 8 | 12 | 20 | 178 | 5 | 10 |

(1.) Deeksharambh (Induction-cum-Foundation Course) of 2 credits (2 weeks duration).
(2.) Farming based Livelihood systems
(3.) NCC/NSS.
(4.) Communication Skills.
(5.) Entrepreneurship Development and BusinessManagement
(6.) Environmental Studies and Disaster Management.
(7.) Personality Development.
(8.) Physical Education, First Aid, Yoga Practices and Meditation.
(9.) Agriculture Marketing and Trade.
(10.) Agriculture Informatics and Artificial Intelligence
(11.) Study tour (10-14 days).
(12.) Only for those opting for an exit with UG-Certificate.
(13.) Only for those opting for an exitwith UG-Diploma
(14.) Introductory Mathmatics / Introductory Biology (Non Gradial)

One multidisciplinary course in Agricultural Engineering discipline is different from the above common courses keeping in view the discipline specific requirement.

**Note:**

- The credit hours mentioned in the Table 1.2 include both theory and practical classes.
- The total credit allocation and the allocation for different types of courses including online courses for some disciplines as per availability of courses are slightly different than those mentioned in the Table 1.2, so as to accommodate the specific need of these disciplines.
- Also, some minor deviations in the courses and credits allocations are allowed across disciplines considering the specific nature of the courses.
- The three-year course curricula of all disciplines of agricultural and allied sciences do not cover the teaching of elective/ specialized courses, that in fact qualify the students in specializing in a particular subject in which the student intends to do further studies. These courses have been presently listed under the 7th and 8th semesters (in IV year). Therefore, the Sixth Deans' Committee is of the view that the option of B. Sc. (Hons.) Agriculture with research may lead to the development of skilled, research oriented and self employable students with complete knowledge and learning of the elective / specialized subjects needed for PG studies and generation of self employment.
- For B. Sc Ag (Hons.) considering the professional nature of thecourses, the exit after at the end of 3rd year (at the end of 6th semester) is not recommended.
- Each class (contact hour) will be of 50 min duration and one practical will be of two contact hours (100 minutes).

## Deeksharambh (Introduction- cum-foundation course)

The goal of higher education is to nurture students by blossoming their hidden potentials to pursue the academic and professional studies in a diligent, honest and responsible manner. It is possible by easing them to develop a sense of integrity with diverse faculties and build linkages with peers, society and community as a whole and lastly be proficient in earning livelihood independently along with sustaining society and nature.

A course entitled Deeksharambh (0+2) (non-gradial) will be offered at the start of first semester for a duration of two weeks. This will be a part of first semester for all purposes including the calculation of Net Instruction Days (NIDs).

The goal of Deeksharambh is to inculcate life skills, develop bonding with mentors, peers and seniors, familiarize with institutional academic framework and functioning, It must educate students to explore their potentials and understand the purpose of their life with reference to serving the community, nation and global society.

Often the incoming undergraduate students are influenced by their parents and relatives to join higher studies, without understanding their own interests and talents. Therefore, the very purpose of initiating Deeksharambh: the induction cum foundation course is to acclimatize the student withthe new surroundings, develop bond with fellow students and teachers. It is the time when a studentshould become clear as to what he/she/ze is going to study in a particular discipline,

or even it is timeto quit and join another discipline of his/ her choice. They must develop sensitivity towards variousissues of social relevance and imbibe human values to become responsible citizens.

Thus, ensuring a well-designed Induction-cum-foundation program by the institutions shall be designed to become helpful to both teachers and students for setting the pace of productive teaching and learning experiences.

**Four Pillars of Deeksharambh**

**Socializing:** Meeting new students, senior students, attend lectures by Eminent People.

**Associating:** Visits to university / college, visits to Dept./Branch/ Program of study and important places on campus, local area, city and so on.

**Acclimatizing** with rules and regulations, student support system, etc.

**Experiencing:** Subject lectures, study skills, small-group activities, physical activity, creative and performing arts, literary activities, universal human values, etc.

**Deeksharambh will create a platform for students to:**

- learn from each other's life experiences,
- help for cultural integration of students from distinct backgrounds,
- know about the operational framework of academic process in university,
- instilling life and social skills,
- social awareness, ethics and values, teamwork, leadership, creativity, etc., and
- Find the traditional values and indigenous cultures along with diverse potentialities both in indigenous and developed scenario.

There will be sessions by alumni, business leaders, outstanding achievers in related fields, people with inspiring life experiences as well as the University academic and research managers. Steps will be taken by the institutions to find the strength and weakness of students (withremedial measures) and diverse potentialities and to enhance cultural Integration of students from different backgrounds.

**Common courses**

The following common courses have been proposed to be offered across the disciplines, whichin addition to giving the students a broader view of agriculture and allied sectors, will enable themfor better communication skills and personality development. Besides, this will also help them to-- look beyond the boundaries of their own subject/ discipline and collaborate in future with othersectors to face the next generation challenges from a holistic point of view.

- Farming based livelihood systems
- Entrepreneurship Development and Business Management
- Agriculture Marketing and Trade
- Communication Skills
- Personality Development
- Environmental Studies and Disaster Management
- Agricultural Informatics and artificial Intelligence

In addition to these common courses and Deeksharambh, the courses as Physical Education, First Aid, Yoga Practices and Meditation, NCC and NSS have also been made compulsory for students for improving social awareness, ethics, moral values and health of the future generation.

**Deficiency courses**

If the student has to take up any deficiency course(s), it must be completed within the first year.

**Entrepreneurship development**

Entrepreneurship is a key driver of the economy of a nation, which has been encouraged through NEP-2020. Expectation is that an early orientation of the young minds towards skill enhancement and entrepreneurship will inculcate entrepreneurial mind set, allowing them to have first-hand experience of working with institutions, organizations, companies, industrial setup and investors to understand their dynamics in the real-world setting.

The restructured undergraduate curricula are designed to enable the students to take up entrepreneurship as a career path. As per NEP-2020, the curricula in all the disciplines of Agricultural education has been refined and fine-tuned with intensive focus on choice-based skill enhancement programs.

- Skill enhancement courses included in following different modes:
- skill enhancement courses in the 1st year and 2nd year as part of the course programs.
- internship for exit programs after 1st year/ 2nd year; and
- advanced skill enhancement through Student READY: Experiential Learning/Hands on Training/Skill development/ RAWE/ Industrial attachment/IPT/ student project and Internshipetc. in 4th year.

Internship can be seen as a mini capsule of intense learning for a student, a way to apply the theory into practice, expand their knowledge base and a platform to integrate all learnings of formalclassroom setup.

Addition of new age courses related to Agriculture, Forestry, Fisheries, Agricultural Engineering, Community Science, Food Nutrition and Dietetics, etc., and incorporation of choice based online courses, which can be taken up from NPTEL, moo KIT, edX, Coursera, SWAYAM or any other portal in open digital learning environment. Practical exercises and teaching methodology are so designed to make the young generation more imaginative, innovative, ingenious, creative and competent.

The skill set bought must make them proactive, pioneering, prospect oriented during their internship or industrial attachment to serve as apprentices in the relevant field. This will empower them to grasp viable avenues of self-employment and entrepreneurship along with diversified career options in different facets of related domains.

**Skill Enhancement Courses**

The skill enhancement programs will be choice based; student can choose the areas of skill enhancement from a bouquet of skill enhancement modules offered by the parent institution. The institutions will develop capabilities for offering such courses.

An institution is at liberty to (and in fact, it should) work in partnership with capable organizations/ companies/ NGOs/ progressive entrepreneurs/ farmers for running various skill enhancement programs.

In the report, for each discipline the list of Skill Enhancement Courses (SEC) has been suggested. The University/ HAEIs may also formulate and offer courses in any other areas as identified by it, based on institutional expertise/ capabilities/ resources. In addition, the skill enhancement courses suggested by the UGC, as listed, may also be offered.

The evaluation of the skill enhancement programs will be as per the evaluation criteria of courses with only practical. However, for the internship programs, the evaluation will be done jointly by the host and parent organisations/ institutions.

**Internship**

The internship proposed under NEP-2020 have been an integral part of agricultural education(as proposed by Fifth Deans' Committee) under the broad category of Student READY programs. It includes various activities such as Experiential Learning/ Hands-on Training, Skill Development Training, Rural Agriculture Work Experience (RAWE), In-Plant Training/ Industrial Attachment and Students' Projects. Therefore, in the recommended structure, the student READY is further strengthened as per NEP-2020 guidelines.

Those students who wish to exit with UG-certificate after one year, has to undergo 10 weeks of internship programme (10 credits) after 1st Year. Similarly, the students who wish to exit with UG-Diploma after second year, has to undergo 10 weeks of internship programme (10 credits) after 2nd Year. The goal of Internship at exit for UG-Certificate and UG-Diploma is to further strengthenskills in the chosen area/ subject.

Internship should be preferably arranged outside of the parent institution at any assigned organization/ industry/ research institution/ project or with a progressive farmer/ agri enterprise, etc.

HAEIs will ensure that the Internship program is aligned with the course that the student has chosen. It is recommended that each HAEI appoints one or more Coordinators for the internship programs. The coordinator must plan/execute/ monitor internship programme implementation atthe institution level.

**Projects**

For some disciplines, projects have been kept as an integral part of the course programme.This will enable the students to develop required competencies and skill in either research or entrepreneurship or potential employment avenues rather than having only mere qualifications,choose right career in research or employment/ entrepreneurship, discover their interests,aptitudes and potentialities and maximise his/ her potentialities and self-confidence. It will alsoadd to creativity and critical thinking of the students. This will also help the students gain research skills and be more innovative in planning, executing, reporting and presenting the things.

**Study tour**

There will be a study tour of 10-14 days' duration during the 6th semester of the UG programme. The students will preferably visit the leading industries/ enterprises/ institutions/ organisations and other places of academic interest outside the state (of location of the institution). This, in addition toexposing the students to the indigenous as well as the latest technologies in their related fields, willalso help the students to know about the socio-economic-cultural variations within the country. Thecourse will be of 0+2 credits, non-gradial.

**Online courses**

The students will have to take a minimum of 10 credits of online courses, which will compriseof one or more courses, as a partial requirement for the UG programme.
(As per UGC guideline, a 1- to 3- credit SWAYAM course is expected to be covered in 4-12weeks' duration including the assessment component, in which it should be 40 hours for 3- credit courses to 80 hours for a 6-credit course for the learning from e-content, reading references material, discussion forum posting and assignment.)

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, SWAYAMor any other portal.

The aim is to allow the students to groom their passion or strengthen their knowledge and competency in any field beyond prescribed courses.

The courses will be non-gradial as separate certificates would be issued by institutes offeringthe courses. **These can be taken any time during the duration of UG program, but preferably duringthe 3rd and 4th years.**

The University/ institute will keep a record of such courses registered and completed by eachstudent and will show the title of the (successfully completed) courses in final transcript issued to the student.

The requirement of credits for online courses for other programs is different due to the specific need of the disciplines.

**Elective courses**

The institutions will offer a bouquet of Elective courses to be offered to the students. The studentswill have the freedom to choose a subject among these courses. The institutions should develop capabilities to offer maximum of the Elective courses proposed in this report. The institutions willalso have the liberty to develop and offer more Elective courses relevant to the subject as per local/regional needs and available expertise. The elective courses can be offered from other disciplines in aUniversity /HAEI.

**Imparting Traditional Knowledge, Values and Ethics**

Due emphasis has been given for imbibing the traditional knowledge, values and ethics amongthe students through different courses like the Deeksharambh, NCC and NSS. It is proposed the study tour shall be conducted across the country to be aware about the socio-cultural-economic status of the people of the country and develop respect for their values and ethics

**Introduction of new degree programs**

Two new degree programs have been proposed in this report in two important areas. Considering the natural strength of the country and future opportunities, a new UG courseon Natural farming has been included. The syllabus is based on Bhartiya Prakartik Krishi Paddhati (BPKP) in India to enhance production, sustainability, saving of water, improvement in soil health and farmland ecosystem and reducing the market inputs. These important aspects of natural farming are considered as cost- effective and suitable for livelihood of large number of farmers and sustainable rural development.

**Light but tight educational programme**

As per the norms of the NEP-2020, the programme has been made light but tight for the students. The total credit hours vary from 166-174 considering the specific need of the professional courses. At the same time, the students have been given the option of the skill development courses, internship, online courses, etc., which will make their learning experience pleasurable and learning more efficient.

## Moderation of courses at institution level

The following flexibility is allowed to the institutions for offering the courses:

A. **Maximum 30% modification in the syllabus for any individual subject.** It is recommendedthe HAEI should consider updating the course curricula around 5% every year. That would enable addition of new contents replacing obsolete/ old contents in the courses.
B. Formulation /addition/ change of Skill Enhancement modules as per needs/ facilities available.
C. Interchange of courses in between semesters within a year (but no change of course shallbe normally allowed in between years).
D. Change of maximum two core courses (If any course is removed from the list of core course, it should be kept as elective), However, the total credit hours should not be lower than the prescribed.
E. Inclusion of any number of courses as Electives and freedom to offer the Elective courses.
F. Modification/ change of credit hours for any four courses (however, total credit hours should not differ by more than four).
G. In case the skill enhancement/ internship programs are conducted in collaboration with industry/ other organizations/ agencies, students may be expected to remain out of the campus for a certain period within the semester. In that situation, the timetable should beso adjusted for the remaining part of the net instruction days (NIDs) of the corresponding semester, which each credit has at least 15 contact hours.

**Central Assistance for strengthening higher agricultural education**

The central Assistance for strengthening higher agricultural education, as proposed by the Fifth Deans' Committee, may be continued.

**Admission Criteria**

The eligibility and mode of admission for entry into the UG programs will be as per the prevailing ICAR/ SAU norms.

Agricultural universities/colleges and other general universities offering agricultural disciplines, will fall under the umbrella of ICAR, as PSSB for agricultural education, as mandated by NEP-2020.

Institutions are at liberty to assess their student intake capacity, and announce the number of seats available in the first semester, and for lateral entries at 3rd semester and 5th semester.

The lateral entry at 3rd semester will be for the candidates having UG-certificate or those whohave completed Diploma (3 years course after 10th) in recognised institutions. The lateral entry in5th semester will be for candidates who have completed UG-Diploma.

There cannot be guarantee for migration to another HAEI. Institutions are at liberty to make their own decisions/ norms/guidelines on the matter of seats and admissions in 3rd and 5th semesters.

**Migration from one University to other**

The UG-Certificate/ UG-Diploma passed candidate from a HAEI will be eligible for admissioninto any agricultural university/institution in the country at appropriate level, provided the admittinguniversity has provision of seats to admit them.

It is recommended to make institutional **migration after 4th semester** more convenient. HAEIsare at liberty to put in place rules/ regulations relaxing/ modifying existing provisions of migration, providing more freedom and ease to students. The migration shall be subject to availability of seatsat the accepting HAEI.

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.

**Exit Option**

There will be three exits during the restructured UG programme. Exit after 1st year: A student may opt to exit after the 1st year of UG programme. However, he/ she has to complete 10 weeks of internship (10 credits) to be eligible for being awarded UG-Certificate degree. (The students going to the higher level need not take 10 weeks internship at thisstage.)

Exit after 2nd year: A student may opt to exit after the 2nd year of UG programme. However,he/she has to complete 10 weeks of internship (10 credits) to be eligible for being awarded UG Deploma. (The students going to the higher level need not take 10 weeks internship at this stage.)

Exit after 4-years programme leading to B.Sc. (Hons.) Agriculture degree.

**Maximum residential period**

Students who exit with a UG- Certificate or UG- Diploma are permitted to re-enter within three academic years and complete the degree programme.

Students may be permitted to take a break from the study during the period of study but the total duration for completing the programme **shall not exceed 7 years.**

**Examination and Evaluation system**

There will be a uniform system of the evaluation and grading to be followed with Grade point average (GPA) system. The following pattern of examination is recommended.

**Table 1.3 Evaluation system**

| | External theory | Internal theory (Mid-term) | Quiz/ progressive assessment | Final Practical |
|---|---|---|---|---|
| For courses having both theory and practical components | 40% | 20% | 20% | 20% |
| For courses with theory only | 50% | 30% | 20% | - |
| Courses with practical only | - | 30% | 20% | 50% (Internal) |

For the external theory examinations, the question paper will be obtained from external experts. The HODs of the respective departments will ensure due coverage of the syllabus with the provision of moderation, if necessary.

The external theory examinations should be of 2 to 2.5 hours' duration and the mid-term examinations should be normally of 1-hour duration. The format of assessment and duration of quizzes/ progressive assessment duration will depend upon the course teacher. Internal practical examination to be conducted by the course instructor and one faculty nominated by the HOD of the concerned department.

The evaluation of the skill enhancement courses will be done as courses with practical only. Usually for any subject, there will be two quizzes within the semester, one before the mid-term and one after. There will be provision of corrections in between, i.e. the students scoring lower than 50% marks or absent in any one quiz can opt for appearing for a third quiz to improve their grades. Theassessment of the students through quizzes should focus on their critical thinking and creativity rather than rote reading.

The quiz and progressive assessment can also be consider in form of group assignments (which should encourage creativity, critical thinking and problem-solving attitude).

The evaluation of internship will be done both by the parent institute and the host industry/ organisation. It should be 50% weightage for each. The student shall submit a report to the parent institute and present the learnings before the other students and faculty after the internship programme. The parent institute may develop the format of evaluation.

The online/MOOC courses, successfully completed by the student, will be shown in the transcript with 'Satisfactory' remark.

When students take deficiency course(s), they will be assessed as 'Satisfactory' or 'Un-satisfactory' without any grade points.

The evaluation will be done on a 10-point scale.

10 point = 100 marks

The per cent of marks in a subject will be divided by 10 to obtain the grade point.The grade point average for a semester will be calculated as follows.

$$GPA = \frac{\sum (\text{Grade point x credit hours}) \text{ in one semester}}{\text{Total credit hours in the semester}}$$

The Cumulative grade point earned at any stage of the course will be calculated as cumulative grade point average (CGPA) as follows.

$$CGPA = \frac{\sum (\text{Grade Point x Credit hours}) \text{ until last semester}}{\text{Total credit hours until last semester}}$$

Total credit hours until last semester If a student passes in a subject in a second attempt, for calculation of CGPA, the grade point for the subject in the second attempt will only be considered. The final CGPA will named as overall grade point average (OGPA), which will be mentioned in the final transcript of the students.

**Award of Divisions**

The award of the divisions will be as follows

**Table 4.4 Award of the divisions**

| OGPA | Division |
|---|---|
| 5 to <6 | Pass |
| 6 to <7 | II division |
| 7 to<8 | I Division |
| >=8 | 1st division and distinction |

**Uniformity in Nomenclature of Degrees**

To ensure hassle free movement of students throughout the country, it is important that nomenclature of degrees awarded is same, across all HAEIs. The nomenclature will be as follows.

**a. UG-Certificate with mention of discipline:** (e.g. UG-Certificate in Agriculture,)

**Note:** If any institution is at present offering any certificate course of the duration of one year or lower, it may continue to do so, but this certificate course will not be considered at par with the UG-Certificate, if the student has not taken admission through the appropriate entrance examination for entry into the 4-year UG program. UG-Diploma with mention of discipline e.g. UG-Diploma in Agriculture.

**Note:** If any institution is at present offering any Diploma course of two years or less than two years' duration after +2 Science/Agriculture. It may continue to do so, but this diploma course will notbe considered at par with the UG-Diploma, if the student has not taken admission through the appropriate entrance examination for entry into the 4-year UG program.

**Academic Bank of Credits (ABC)**

As per NEP-2020 guidelines, the HAEI will create an Academic Bank of Credits (ABC) of each student and recognize the ABC of a student as per the norms of the HAEI/ NEP-2020 recommendations.

**Blended learning:** Blended learning has gained tremendous popularity as it combines the benefits of traditional classroom teaching with emerging technology and online educational resources to make learning more real-time, contextual, and engaging. This provision will enable blended learning to expand theopen /distance learning options and to promote extensive use of technology in learning and skilling. This would help in overcoming the constraints of physical infrastructure and scalability while enhancing access, equity, and affordability and ensuring quality and accountability. The blended learning option shall also enhance accessibility of learning for Divyangs.

# Faculty of Agriculture

**GRADUATION REQUIREMENT OF B.SC. (HONS) AGRICULTURE PROGRAMME FOR STUDENTS ADMITTED FROM ACADEMIC YEAR 2025-26 AND ONWARDS IN ACCORDANCE WITH ICAR SIXTH DEAN'S COMMITTEE RECOMMENDATION ON RESTRUCTURING B.SC. AGRICULTURE (HONS) PROGRAMME TO IMPLEMENT NEP -2020 POLICY.**

**Eligibility for entry into 1st year UG programme:** 10+2 Science with Biology or Maths or Agriculture stream.

**Nomenclature:**

- **UG-Certificate in Agriculture** if the student quits after completion of First year courses and 10- week internship.
- **UG-Diploma in agriculture** if the student quits after completion of second year courses and 10 –weeks internship

- **B.Sc. (Hons) Agriculture** upon completion of four-year programme. In this programme total number of 179 credit hours (169 credits classroom mode + 10 credits from online courses) must be required to complete the course.

**Note- * Student will be offered any one course according to his/her stream in Intermediate. Students having mathematics background in Intermediate shall be offered Introductory Biology while those having Biology and Agriculture background shall be offered Introductory Mathematics.**

**** Students can opt any one of these two.**

## ACADEMIC PROGRAMME
### First year
### I Semester

| Course No. | Name of Course | Credit | Total Credit |
|---|---|---|---|
| S0148001 | Deeksharambh (Induction Cum Foundation Course & Non Gradial Course) | 2(0+2) | 25(12+13) |
| S0148002 | Skill Enhancement Course-I From (SEC-I) | 2(0+2) | |
| S0148003 | Skill Enhancement Course-II From (SEC-II) | 2(0+2) | |
| S0148004 | Communication Skills | 2(1+1) | |
| S0148005 | Rural Sociology and Educational Psychology | 2(2+0) | |
| S0148006 | Fundamentals of Agronomy | 3(2+1) | |
| S0148007 | Farming based livelihood systems | 3(2+1) | |
| S0148008 | Fundamentals of Soil Science | 3(2+1) | |
| S0148009 | Fundamentals of Horticulture | 3(2+1) | |
| S0148010 | Principles of Dairy Science | 2(1+1) | |
| S0148011*/ S0148012* | Introductory mathematics / Introductory Biology (need based) (Non Gradial Course) | 1(1+0)/1(1+0) | |
| S0148013**/ S0148014** | National Service Scheme (NSS-I) /National Cadet Corps (NCC-I) | 1(0+1) | |

### II Semester

| Course No. | Name of Course | Credit | Total Credit |
|---|---|---|---|
| S0248001 | Skill Enhancement course-III From (SEC-III) | 2(0+2) | 21(10+11) (Total Credit Hours = 21) |
| S0248002 | Skill Enhancement course-IV From (SEC-IV) | 2(0+2) | |
| S0248003 | Personality Development | 2(1+1) | |
| S0248004 | Environmental Studies and Disaster Management | 3(2+1) | |
| S0248005 | Soil Fertility Management | 3(2+1) | |
| S0248006 | Fundamentals of Entomology | 3(2+1) | |
| S0248007 | Livestock & Poultry Management | 2(1+1) | |
| S0248008 | Fundamentals of Plant Pathology | 3(2+1) | |
| S0248009**/ S0248010** | NSS-II/ NCC-II | 1(0+1) | |
| S0248012 | Internship of 10-weeks duration | 10 (0+10) Only for Exit opting students | |

**Second year**
**III Semester**

| Course No. | Name of Course | Credit | Total Credit |
|---|---|---|---|
| S0348001 | Skill Enhancement course-V From (SEC-V) | 2(0+2) | 23(10+13) |
| S0348002 | Entrepreneurship Development and Business Communication | 3(2+1) | |
| S0348003 | Physical Education, First Aid,Yoga Practices and Meditation | 2(0+2) | |
| S0348004 | Principles of Genetics | 3(2+1) | |
| S0348005 | Crop Production Technology-I (*Kharif* crops) | 2(1+1) | |
| S0348006 | Production Technology of Fruit and Plantation Crops | 2(1+1) | |
| S0348007 | Fundamentals of Extension Education | 2(1+1) | |
| S0348008 | Fundamentals of Nematology | 2(1+1) | |
| S0348009 | Principles and Practices of Natural Farming | 2(1+1) | |
| S0348010 | Practical Crop Production – I (Kharif Crops) | 1(0+1) | |
| S0348011 | Chemistry of Dairy Products | 2(1+1) | |

**IV Semester**

| Course No. | Name of Course | Credit | Total credit |
|---|---|---|---|
| S0448001 | Skill Enhancement course-VI From/(SEC-VI) | 2(0+2) | 24(13+11) |
| S0448002 | Agricultural Informatics and Artificial Intelligence | 3(2+1) | |
| S0448003 | Production Technology of Vegetables and Spices | 2(1+1) | |
| S0448004 | Principles of Agricultural Economics and Farm Management | 2(2+0) | |
| S0448005 | Crop Production Technology-II (*Rabi* Crops) | 2(1+1) | |
| S0448006 | Farm Machinery and Power | 2(1+1) | |
| S0448007 | Water Management | 2 (1+1) | |
| S0448008 | Problematic Soils & Their Management | 2(1+1) | |
| S0448009 | Basics of Plant Breeding | 3(2+1) | |
| S0448010 | Practical Crop Production – I (Rabi Crops) | 1(0+1) | |
| S0448011 | Beneficial Insects and Pests of Horticultural Crops and Their Management | 3(2+1) | |
| S0448012 | Internship of 10-weeks duration | 10 (0+10) only for EXIT opting students | |

**Third year V Semester**

| Course No. | Name of Course | Credit | Total credit |
|---|---|---|---|
| S0548001 | Agricultural Marketing and Trade | 3(2+1) | |
| S0548002 | Introduction to Agro-meteorology | 2(1+1) | |
| S0548003 | Fundamentals of Crop Physiology | 3(2+1) | |
| S0548004 | Pest management in Crops and Stored Grains | 3(2+1) | |

| | | | |
|---|---|---|---|
| S0548005 | Diseases of Field & Horticultural Crops& their Management | 3(2+1) | 24 (14+10) |
| S0548006 | Crop Improvement (*kharif* crops)-I | 2(1+1) | |
| S0548007 | Weed Management | 2(1+1) | |
| S0548008 | Ornamental Crops, MAPs, and Landscaping | 2(1+1) | |
| S0548009 | Introductory Agro forestry | 2(1+1) | |
| S0548010 | Chemistry of Dairy Products | 2(1+1) | |
| S0548011 | Online Course | 5 Credits | |

**VI Semester**

| Course No. | Name of Course | Credit | Total credit |
|---|---|---|---|
| S0648001 | Fundamentals of Agri Biotechnology | 3(2+1) | 23(13+10) |
| S0648002 | Basic and Applied Agricultural Statistics | 3(2+1) | |
| S0648003 | Crop Improvement (*Rabi* crops)-II | 2(1+1) | |
| S0648004 | Renewable energy in Agriculture and Allied Sector | 2(1+1) | |
| S0648005 | Dry land agriculture/Rainfed agriculture and water shed management | 2(1+1) | |
| S0648006 | Agricultural Microbiology and Phyto-remediation | 2(1+1) | |
| S0648007 | Agricultural Finance & Cooperation | 2(1+1) | |
| S0648008 | Essentials of Plant Biochemistry | 3(2+1) | |
| S0648009 | Fundamentals of Seed Science &Technology | 2(1+1) | |
| S0348010 | Insect Ecology & Integrated pest management | 2(1+1) | |
| S0648011 | Study Tour (Non Gradial Course) | 2(0+2) | |

**Fourth Year VII Semester**

| **List of Elective Courses (Choose any five)** | | | | |
|---|---|---|---|---|
| **Course No.** | **Name of Course** | **Department** | **Credit** | **Total credit** |
| S0748001 | Agri-Business Management | Ag. Economics | 4(3+1) | 20 (15+5) |
| S0748002 | Management of Natural resources | Ag. Engineering | 4(3+1) | |
| S0748003 | Agrochemicals | Soil Science &Ag Chemistry | 4(3+1) | |
| S0748004 | Landscaping | Horticulture | 4(3+1) | |
| S0748005 | Commercial Plant breeding | Genetics and Plant Breeding | 4(3+1) | |
| S0748006 | Food Safety and standards | A.H. & Dairying | 4(3+1) | |
| S0748007 | System Simulation and Agro advisory | Ag. Engineering | 4(3+1) | |
| S0748008 | Hi-tech Horticulture | Horticulture | 4(3+1) | |
| S0748009 | Protected cultivation | Horticulture | 4(3+1) | |
| S0748010 | Micro-propagation Technologies | Horticulture | 4(3+1) | |
| S0748011 | Commercial Seed Production | Genetics and Plant Breeding | 4(3+1) | |

| | | | | |
|---|---|---|---|---|
| S0748012 | Principles and Practices of organic farming & conservation agriculture | Agronomy | 4(3+1) | |
| S0748013 | Post-Harvest Technology and value addition | Horticulture | 4(3+1) | |
| S0748014 | Agricultural Journalism | Ag. Extension | 4(3+1) | |
| S0748015 | Climate resilient Agriculture | Agronomy | 4(3+1) | |

***Students can opt any five elective courses from the above given list according to the availability of the resources and facilities available within the department/college/university.**
***Other than elective course student must complete 5 credit through online cources.**

**VIII Semester**

Student READY: RAWE/ Industrial Attachment / Experiential Learning / Hands on Training / Project work / Internship)

A student must register 20 credits opting for **Two Modules of (0+10)** credits each **(Total 20 Credits)** from the package of modules. Each module selected must be from other diciplene.

| Course code | Title of module | Department | Credits |
|---|---|---|---|
| **SRP-S0848001** | Farming System development | Agronomy | 0+10 |
| SRP-**S0848002** | Production Technology for Bio-agents and Bio fertilizer | Entomology | 0+10 |
| SRP-**S0848003** | Mushroom Cultivation Technology | Plant Pathology | 0+10 |
| SRP-**S0848004** | Soil, Plant, Water Testing | Soil Science & Ag Chemistry | 0+10 |
| SRP-**S0848005** | Poultry Production Technology | A.H. & Dairying | 0+10 |
| SRP-**S0848006** | Commercial Horticulture | Horticulture | 0+10 |
| SRP-**S0848007** | Food Processing | A.H. & Dairying | 0+10 |
| SRP-**S0848008** | Organic Manure Production Technology | Soil Science & Agriculture Chemistry | 0+10 |
| SRP-**S0848009** | Commercial Sericulture | Entomology | 0+10 |

| | | |
|---|---|---|
| | Student READY: RAWE / Industrial Attachment/ Experiential Learning/ Hands on Training / Project work/ Internship) | 20 |
| | **Total credit** | 178 |
| | Online courses | 10 |
| | Grand total | 188 |

## Department/Section wise Course breakup

### Agronomy

| Course No. | Name of Course | Credit |
|---|---|---|
| **S0148006** | Fundamentals of Agronomy | 3(2+1) |
| **S0148007** | Farming based livelihood systems | 3(2+1) |
| **S0348005** | Crop Production Technology-I (Kharif Crops) | 2(1+1) |
| **S0348009** | Principles and Practices of Natural Farming | 2 (1+1) |
| **S0348010** | Practical Crop Production – I (Kharif Crops) | 1(0+1) |

| | | |
|---|---|---|
| **S0448005** | Crop Production Technology-1I (Rabi Crops) | 2(1+1) |
| **S0448007** | Water Management | 2 (1+1) |
| **S0448011** | Practical Crop Production – I (Rabi Crops) | 1(0+1) |
| **S0548007** | Weed Management | 2 (1+1) |
| **S0648005** | Dry land agriculture/Rainfed agriculture and watershed management | 2 (1+1) |

## Soil Science & Agriculture Chemistry

| Course No. | Name of Course | Credit |
|---|---|---|
| **S0148008** | Fundamentals of Soil Science | 3(2+1) |
| **S0248004** | Environment Studies and Disaster Management | 3 (2+1) |
| **S0248005** | Soil Fertility Management | 3(2+1) |
| **S0448008** | Problematic Soils and their management | 2 (1+1) |
| **S0648008** | Essentials of Plant Biochemistry | 2 (1+1) |

## Horticulture

| Course No. | Name of Course | Credit |
|---|---|---|
| **S0148009** | Fundamentals of Horticulture | 3(2+1) |
| **S0348006** | Production Technology of Fruit and Plantation Crops | 2 (1+1) |
| **S0448003** | Production Technology of Vegetables and Spices | 2 (1+1) |
| **S0548008** | Ornamental Crops, MAP's and Landscaping | 2 (1+1) |
| **S0548009** | Introductory Agro forestry | 2 (1+1) |

## Genetics and Plant Breeding

| Course No. | Name of Course | Credit |
|---|---|---|
| **S0148011** | Introductory Biology (Non Gradial Course) * | 1(1+1) |
| **S0348004** | Principles of Genetics | 3(2+1) |
| **S0448009** | Basics of Plant Breeding | 3(2+1) |
| **S0548003** | Fundamentals of Physiology | 3 (2+1) |
| **S0548006** | Crops Improvement (kharif crops)-I | 2 (1+1) |
| **S0648001** | Fundamentals of Agricultural Bio-technology | 3 (2+1) |
| **S0648003** | Crops Improvement (Rabi crops)-II | 2 (1+1) |
| **S0648009** | Fundamentals of Seed Science and Technology | 2 (1+1) |

## Entomology

| Course No. | Name of Course | Credit |
|---|---|---|
| **S0248006** | Fundamentals of Entomology | 3(2+1) |
| **S0348010** | Insect Ecology & Integrated pest management | 2(1+1) |
| **S0448011** | Beneficial Insects and Pests of Horticultural Crops and Their Management | 3(2+1) |
| **S0548004** | Pest management in crops and stored grains | 3(2+1) |

## Plant Pathology

| Course No. | Name of Course | Credit |
|---|---|---|
| **S0248008** | Fundamentals of Plant Pathology | 3(2+1) |
| **S0348008** | Fundamentals of Nematology | 2 (1+1) |
| **S0548005** | Diseases of Field & Horticulture Crops & their Management | 3(2+1) |
| **S0648006** | Agricultural Microbiology and Phyto-remediation | 2 (1+1) |

## Agricultural Extension Education

| Course No. | Name of Course | Credit |
|---|---|---|
| **S0148004** | Communication Skills | 2 (1+1) |
| **S0148005** | Rural Sociology and Educational Psychology | 2 (2+0) |
| **S0248003** | Personality development | 2 (1+1) |

| | | |
|---|---|---|
| **S0348007** | Fundamentals of Extension Education | 2 (1+1) |

## Agricultural Economics

| Course No. | Name of Course | Credit |
|---|---|---|
| **S0348002** | Entrepreneurship Development and Business Communication | 3 (2+1) |
| **S0448004** | Principles of Agricultural Economics and Farm management | 2 (2+0) |
| **S0548001** | Agricultural marketing and Trade | 2 (1+1) |
| **S0648007** | Agricultural Finance & Cooperation | 2 (1+1) |

## Agricultural Statistics

| Course No. | Name of Course | Credit |
|---|---|---|
| **S0148010** | Introductory Mathematics (Non Gradial Course) * | 1 (1+0) |
| **S0448002** | Agricultural Informatics and Artificial Intelligence | 3 (2+1) |
| **S0648002** | Basic and Applied Agril Statistics | 3 (2+1) |

## Agricultural Engineering

| Course No. | Name of Course | Credit |
|---|---|---|
| **S0448006** | Farm Machinery and Power | 2 (1+1) |
| **S0548002** | Introduction to Agro-meteorology | 2 (1+1) |
| **S0648004** | Renewable energy in Agriculture and Allied Sector | 2 (1+1) |

## Animal Husbandry & Dairying

| Course No. | Name of Course | Credit |
|---|---|---|
| **S0148010** | Principles of Dairy Science | 2(1+1) |
| **S0248007** | Livestock and Poultry Management | 2 (1+1) |
| **S0348011** | Chemistry of Dairy products | 2(1+1) |

## Students Welfare

| Course No. | Name of Course | Credit |
|---|---|---|
| **S0148012/13** | NSS/ NCC -I | 1 (0+1) |
| **S0248009/10** | NSS /NCC -II | 1 (0+1) |
| **S0348003** | Physical Education, First Aid and yoga Practices | 2 (0+2) |
| **S0648011** | Study Tour | 2 (0+2) |

## Skill Enhancement Courses (SECs)

**SKILL ENHANCEMENT COURSE (SEC)**

A student admitted into 1st year of B.Sc. (Hons) Agriculture degree program will take 2 skill enhancement courses each of 2 credits in each semester of first year. Likewise, the student continuing his study into 2nd year of B.Sc. (Hons) Agriculture will undergo 1 skill enhancement course of 2 credits in each of the 2 semesters of 2nd year.

The student can select these courses from a bouquet of skill enhancement courses as indicatedbelow or courses offered by a college. The courses may be offered as module of complementing courses to help the student to achieve skill in a specific area of his interest.

The University/HAEIs may offer such skill enhancement courses in which it has strength/ expertise as well as there is prospect of local employment and entrepreneurship development. The courses included in the list are indicative and the University/HAEIs may add more need-based courses in the list depending on their facilities and expertise available. The students can opt only two skill enhancement courses from section I as well as section II (one from each section) in first semester. Like wise students can opt only two courses from III and IV (one from each section) in second

semester, and only one course from section V as well as VI in third and fourth semester respectively.

**Indicative skill Enhancement courses**

| S. No | Section | **Course No.** | Course title | Department | Total credits |
|---|---|---|---|---|---|
| 1. | SEC-I | S0148002 | Agriculture Waste Management | Soil Science & Ag Chemistry | 2 (0+2) |
| 2. | | | Organic Production Technology | Agronomy | 2 (0+2) |
| 3. | SEC-II | S0148003 | Post-harvest Processing Technology | Horticulture | 2 (0+2) |
| 4. | | | Plantation, Crop Production and Processing | Horticulture | 2 (0+2) |
| 5. | | | Commercial Horticulture | Horticulture | 2 (0+2) |
| 6. | | | Floriculture and Landscaping | Horticulture | 2 (0+2) |
| 7. | | | Protected Cultivation & Nursery Management | Horticulture | 2 (0+2) |
| 8. | SEC-III | S0248001 | Seed Production and Testing Technology | Genetics & P.B. | 2 (0+2) |
| 9. | | | Soil, Plant and Water Testing | Soil Science & Ag. Chemistry | 2 (0+2) |
| 10. | SEC-IV | S0248002 | Commercial Apiculture | Entomology | 2 (0+2) |
| 11. | | | Biofertlizer and biopesticide production | Entomology | 2 (0+2) |
| 12. | | | Production Technology of Bioagents | Plant Pathology | 2 (0+2) |
| 13. | | | Mushroom Production Technology | Plant Pathology | 2 (0+2) |
| 14. | SEC-V | S0348001 | Video Production | Ag. Extension | 2 (0+2) |
| 15. | | | Food Processing | A.H. & Dairying | 2 (0+2) |
| 16. | | | Basic of Agricultural Start-ups and Entrepreneurship | Ag. Economics | 2 (0+2) |
| 17. | | | Dairy Business Management | Ag. Economics | 2 (0+2) |
| 18. | SEC-VI | S0448001 | Poultry Production Technology | A.H. & Dairying | 2 (0+2) |
| 19. | | | Piggery Production Technology | A.H. & Dairying | 2 (0+2) |
| 20. | | | Value Added Milk Product Technology | A.H. & Dairying | 2 (0+2) |

**ONLINE COURSES**

The students will have to take a minimum of 10 credits of online courses (as per UGC guidelines for online courses) as a partial requirement for the B.Sc. (Hons) Agriculture.

The online courses can be from any field such as Agricultural Science, Basic Sciences, Humanities, Commerce, Business Management, Languages including foreign language, Communication skills, Music, Data Science, Computer Science etc. and can be taken from SWAYAM, Diksha, NPTEL, mooKIT, edX, Coursera, or any other portal.

The objective is to allow the students to groom their passion or strengthen their knowledge and competency in any field beyond prescribed courses.

The students will take prior approval of the courses they opt from the concerned Dean/Assoc. Dean/Principal of the Faculty/College/Institute.

The courses will be non-gradial as separate certificates would be issued by the Institute/ University offering the courses. However, the University/ institute will keep a record of such courses registered and completed by each student and will indicate the title of the (successfully completed) courses in final transcript issued to the student.

# Syllabi of Different Disciplines
# Agriculture
## Detailed Syllabi
## Semester-I

### S0148001 *Deeksharambh* (Induction-cum-Foundation Course)-Non gradial 2 (0+2)

**Objectives**

- Help for cultural integration of students from diverse backgrounds,
- Know about the operational framework of academic process in the University/College/Institute
- Instilling life and social skills,
- Social Awareness, Ethics and Values, Teamwork, Leadership, Creativity, etc.
- Identify the traditional values and indigenous cultures along with diverse potentialities both inindigenous and developed scenario.
- Identify strength and weakness of the students in different core areas of the discipline.

The parent universities will decide the details of activities. The structure shall include,but not restricted to:

i. Discussions on operational framework of academic process in the University, as well as interactions with academic and research managers of the University
ii. Interaction with alumni, business leaders, perspective employers, outstanding achievers in related fields, and people with inspiring life experiences
iii. Group activities to show the strength and weakness of students (with expert advice for their improvement) as well as to create a platform for students to learn from each other's life experiences
iv. Activities to enhance cultural Integration of students from divergent backgrounds.
v. Field visits to related fields/ establishments
vi. Sessions on personality development (instilling life and social skills, social awareness, ethics and values, teamwork, leadership, etc.) and communication skills

### S0148004 Communication Skills 2 (1+1)

**Objectives**

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

**Theory**

**Communication Process:** The magic of effective communication; Building self-esteem and overcoming fears; Concept, nature, and significance of communication process; Meaning, types and models of communication; Verbal and non-verbal communication; Linguistic and non-linguistic barriers to communication and reasons behind communication gap/ miscommunication.

**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.

**Structural and Functional Grammar:** Sentence structure, modifiers, connecting words and verbal; 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.

**Practical**

Listening and note taking; Writing skills: precis writing, summarizing and abstracting; Readingand 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.

**Suggested readings**


1. Allport, G. W.1937. Personality: A Psychological Interpretation. Holt, New York.
2. Brown Michele and Gyles Brandreth. 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 Pushpa Lata. 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


## S0148005 Rural Sociology and Educational Psychology 2 (2+0)

**Objective:**

Provide knowledge on concept and importance of sociology and rural sociology as well as the relationship with Extension Education

**Theory:**

Extension Education and Agricultural Extension: Meaning, definition, scope, and importance. Sociology and rural sociology: Meaning, definition, scope, importance of rural sociologyin 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. 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. 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. 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. Leadership: Meaning, definition, classification, roles of leader, different methods of selection of professional and lay leaders. Training of Leaders: Meaning, definition, methods of training, Advantages and limitations in use of local leaders in Agricultural Extension, Psychology and educational psychology: Meaning, definition, scope, and importance of educational psychology in Agricultural Extension. Intelligence: Meaning, definition, types, factors affecting intelligence and importance of intelligence in Agricultural Extension. Personality: Meaning, definition, types, factors influencing the personality and role of personality in agricultural Extension. Teaching: Learning process: Meaning and definition of teaching, learning, learning experience and learning situation, elements of learning situation and its characteristics. Principles of learning and their implication of teaching.

**Suggested readings:**


1. AR. Desai -Rural Sociology in India
2. Dahama O. P. and Bhatnagar, O. P. - Education and Communication for Development
3. J.B. Chitambar -Introductory Rural Sociology
4. M.B. Ghorpade- Essential of psychology
5. Prepared You Tube videos
6. R Velusamy Textbook on Rural Sociology and Educational Psychology
7. Ray, G. L. -Extension Communication and Management
8. Sandhu A. S. -Textbook on Agricultural Communication
9. Web Materials


## S0148006 Fundamentals of Agronomy 3 (2 +1)

**Objectives:**

To impart the basic and fundamental knowledge of Agronomy

**Theory:**

**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, fields crops and classification, importance, ecology and ecosystem. Seeds and sowing: Definitionsof crops, variety and seed. Factors affecting crop stands establishment: good quality seed, proper tillage, time of sowing seed rate, depth and method of sowing: broadcasting, drilling, dibbling, transplanting etc. Tillage and tilth: Definition, objectives, types, advantages and disadvantages of tillage including conservation tillage. Crop density and geometry: plant geometry and planting geometry, its effect on growth, yield.

**Crop nutrition:** Definition of essential nutrients, criteria of essentiality, functional elements, classification of essential nutrients, role of macro and micro nutrients. Nutrient absorption, active and passive absorption of nutrients, forms of plant nutrients absorbed by plants, Combined /un-combined forms. Manures and fertilizers, nutrient use efficiency: Sources of nutrients: Inorganic (fertilizers), organic (manures) and bio-fertilizers; their classification and characteristics, method of preparation and role of organic manures in crop production. Integrated Nutrient Management (INM): Meaning, different approaches and advantages of INM. Green manure- role in crop production: Definition, objectives types of green manuring, desirable characteristics, advantages and limitations of green manuring.

**Water management:** Water resources of the world, India and the state; Soil Moisture constants: gravitational water, capillary water, hygroscopic water, Soil moisture constants.

Weeds: Definition, Importance and basics of classification of weeds and their control. Agro-climatic 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, Growth and development of crops: Definition, Meaning and factors affecting growth and development.

**Practical:**

A visit to Instructional Crop farm and study on field crops, 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.

**Suggested readings:**


1. Rao V S. 1992. Principles of Weed Science. Oxford and IBH Publishing Co. Ltd. New Delhi.
2. Reddy Yellamanda T and Shankar Reddy G H. 1995. Principles of Agronomy. Kalyani Publishers, Ludhiana.
3. Reddy, S. R. 2008. Principle of Crop Production, Kalyani Publisher, Ludhiana.
4. William L Donn. 1965. Meteorology. McGraw-Hill Book Co. New York.
5. Yawalkar K S and Agarwal J P. 1977. Manures and Fertilizers. Agricultural Horticultural Publishing House, Nagpur.


## S0148007 Farming based livelihood system 3(2+1)

**Objective:**

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 oflivelihood

**Theory:**

Status of agriculture in India and different states, Income of farmers and rural people inIndia, Livelihood-Definition, concept and livelihood pattern in urban and rural areas, Different indicators to study livelihood systems. Agricultural livelihood systems (ALS): Meaning, approach, approaches and framework, 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- Crops and cropping systems, Livestock (Dairy, Piggery, Goatry, Poultry, Duckry etc.), Horticultural crops, Agro--forestry systems, Aqua culture Duck/Poultry cum Fish, Dairy cum Fish, Piggery cum Fish etc., Small-, medium- and large- enterprises including value chains and secondary enterprises as livelihood components for farmers, 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, 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 21$^{st}$ Century in view of circular economy, green economy, climate change, digitalization and changing lifestyle.

**Practical:**

Survey of farming systems and agricultural based livelihood enterprises, Study of componentsof 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.

**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 – RegionalAnalysis: 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,
7. 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
8. Panwar et al. 2020. Integrated Farming System models for Agricultural Diversification, Enhanced Income and employment, Indian Council of Agricultural Research, New Delhi.
9. Reddy, S.R. 2016. Farming System and Sustainable Agriculture, Kalyani Publishers, New Delhi.
10. Singh, J.P., et al. 2015. Region Specific Integrated Farming System Models, ICAR-Indian Institute of Farming Systems Research, Modipuram.
11. Walia, S. S. and Walia, U. S. 2020. Farming System and Sustainable Agriculture, ScientificPublishers, Jodhpur, Rajasthan.


## S0148008 Fundamentals of Soil Science 3 (2+1)

**Objective:**

To impart knowledge on soil genesis, basic soil properties with respect to plant growth Catalogue description

**Theory:**

Soil: Pedological and edaphalogical concepts. Rocks and minerals, weathering, Silicate clays: constitution and properties, sources of charge, ion exchange, cation and anion exchange capacity and base saturation (after buffering capacity), Soil formation, Soil organic matter, Pedogenic processes, Soil colloids: inorganic and organic, Properties of soil colloids and Ion exchange in soils, Soil profile, soil texture, soil structure. Bulk density and particle density, soil consistency, soil temperature, soil air, soil water. Soil reaction and buffering capacity. Soil taxonomy, keys to soil orders. Soils of India.

**Practical:**

Study of general properties of minerals, study of minerals-silicate and non-silicate minerals, study of rocks-igneous, sedimentary and metamorphic rocks; study of a soil profile, collection and processing of soil for analysis, study of soil texture-feel method, mechanical analysis, determination particle density and soil porosity, determination of soil colour, study of soil structure and aggregate analysis, determination of soil moisture, determination of soil moisture constants-

field capacity; water holding capacity. Study of infiltration rate of soil, determination of pH and Electrical conductivity of soil.

**Suggested readings:**


1. Brady, Nyle C. and Well, Ray R. 2014. Nature and Properties of Soils. Pearson Education Inc., New Delhi.
2. Biswas, T.D. and Mukherjee, S.K. 1994. Text Book of Soil Science. Tata Mc Graw Hill Pub. Co. Pvt. Ltd., New Delhi.
3. Das, D. K. 2020. Introductory Soil Science –Kalyani Publishers
4. ISSS. 2002 Fundamentals of Soil Science. Published by Indian Society of Soil Science, New Delhi
5. Donahue, R.L., Miller, R.W. and Shickluna, J.C. 1992. An Introduction to Soilsand Plant Growth (7th ed.) Prentice Hall of India Pvt. Ltd., New Delhi
6. R K Mehra 2006. Textbook of Soil Science, ICAR, New Delhi.
7. White, H. 1990. Introduction to Principles and Practices of Soil Science. Oxford Publ., London.


## S0148009 Fundamental of Horticulture 3(2+1)

**Objectives:**

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 andnutrient management of horticultural crops
3. To provide knowledge on different physiological aspects of horticultural crops

**Theory:**

**Horticulture:** Its different branches, importance and scope, Horticulture and botanical classification, soil and climate for horticultural crops. Plant propagation: methods and propagation structures, seed dormancy and seed germination, Merits and demerits of sexual and asexual propagation Stock-scion relationship.

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

**Suggested readings**


1. Basics of Horticulture by Jitendra Singh
2. Introduction to Horticulture by N. Kumar
3. Handbook of Horticulture by ICAR


## S0148010 Principles of Dairy Science **Credit Hours:** 2(1+1)

**Objective:** To provide students with a foundational understanding of milk production, processing, and the various dairy products derived from it.

**Theory:**

Concept of Dairying, Dairying in India, Dairy development in different five year plans. Dairy production statistics. Cleaning and sanitization of dairy equipment. Dairy cooperatives, Functioning of dairy cooperatives societies, Functioning of Anand Pattern, White revolution, Objectives and achievements of operation flood. Milk and its secretion, Transportation and milk distribution, pricing policy of milk. platform tests, Filtration. Straining and Clarification of milk. Standardization, Milk adulteration and its detection, Preservation and Common preservatives of milk and their detection, Legal standards of milk. Factors affecting the quality and quantity of milk, Nutritive value of milk and milk product. Basic principles of refrigeration and cold storage of milk and milk product. Adulteration and Common adulterants of ghee, khoa and their detection. Milk and milk product packaging, marketing and cost analysis.

**Practical:**

Sampling of milk, C.O.B. Test, M.B.R. Test, Sediment test, Problems on Standardization, Detection of adulterants viz. water, starch, sucrose, urea, detergent and refined oil, Problems on adulteration, Hansa Test, Detection of preservatives, Alcohol test, and Acidity of milk.

**Suggested readings:**


**1. Bhati, S. S. and Lawaniya, G. S. 1990-91.** *Dairying*. V. K. Prakashan, Baraut (meerut).

**2. Jauhar, I. J. and Gupta, R. G.** *Dairy Technology and Quality Control***.** Rama publishing House, Meerut.

**3. De Sukumar.2004.** *Outlines of Dairy Technology 20th Impression*. Published by Manzar Khan, Oxford University Press YMCA Library Building, Jai Singh Road, New Delhi-110001.

**4. Jauhar, I. J. and Gupta, R. G.2013.** *Milk, Milk Processing and Human Nutrition*. Rama Publishing House, Delhi Road, Meerut.

**5. Varnam, A. H. and Sutherland, J. P. 2001.** *Milk and Milk Products Technology, chemistry and Microbiology*. Aspen Publishers, Inc.200 orchard Ridge Drive Galthersberg, MD 20878.

**6. Singh, T. B.** Dairy Chemistry and Animal Nutrition. Kukka Publishing House Baraut, Meerut.

**7. Chandan, R. C.; Kirala, A. and Shah, N. P. 2009.** *Dairy Processing and Quality Assurance.* Willey-Blackwell, A John Willey & Sons Limited Publication


## S0148011 Introductory Mathematics (Non-gradial) 1 (1+0)

**Matrices:** Definition of Matrices, Addition, Subtraction, Multiplication, Transpose and Inverse up to 3rd order by ad joint method, Properties of determinants up to 3rd order and their evaluation.

**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.

Integral Calculus: Integration- Definite and Indefinite Integrals-Methods- Integration by substitution, Integration by parts. Area under simple well-Known curves.

**Mathematical Models:** Agricultural systems -Mathematical models- Classification of mathematical models-fitting of Linear, Quadratic and exponential models to experimental data.

**Suggested readings:**


1. R.S. Agrawal, Class XI and XII (Bharti Bhavan Pvt. Ltd),
2. M.L. Agrawal, Class XI and XII (Arya publications),
3. Mathematics NCERT books of class XI and XII

## S0148012 Introductory Biology (Non-gradial) 1 (1+0)

**Theory** Introduction to the living world, diversity and characteristics of life, origin of life, Evolution and Eugenics. Binomial nomenclature and classification Cell and cell division. Morphology of flowing plants. Seed and seed germination. Plant systematic- viz; Brassicaccac, Fabaccac and Poaceae. Role of animals in agriculture. Morphology of flowering plants - root, stem and leaf and their modifications. Inference, flower and fruits. Cell, tissues & cell division. Internal structure of root, stem and leaf. Study of specimens and slides. Description of plants - Brassicaccae. Fabaceac and Poaceae.

**Suggested readings:**

1. B.P. Pandey, Elementary of Botany

## S0148013/ S0148014 National Service Scheme (NSS-I)/ National Cadet Corps (NCC-1), 1 (0+1)

## National Service Scheme (NSS)

Evoking social consciousness among students through various activities viz., working together, constructive, and creative social work, to be skilful in executing democratic leadership, developing skill in programme, to be able to seek self-employment, reducing gap between educated and uneducated, increasing awareness and desire to help sections of society.

All the activities related to the National Service Scheme are distributed under four different courses viz., National Service Scheme I, National Service Scheme II, National Service Scheme III and National Service Scheme IV: each having one credit load.

The entire four courses should be offered continuously for two years. A student enrolled in NSS course should put in at least 60 hours of social work in different activities in a semester otherthan five regular one-day camp in a year and one special camp for duration of 7 days at any semesterbreak period in the two years. Different activities will include orientation lectures and practical works. Activities directed by the Central and State Government must be performed by all the volunteers of NSS as per direction.

**Introduction and Basic Components of NSS**

i. Orientation: history, aims, principles, symbol, badge; regular programs under NSS
ii. Organizational structure of NSS, Code of conduct for NSS volunteers, points to be consideredby NSS volunteers' awareness about health.
iii. NSS program activities: Concept of regular activities, special camping, day camps, basis of adoption of village/slums, conducting survey, analyzing guiding financial patterns of scheme, youth program/ schemes of GOI, coordination with different agencies and maintenance of diary. Understanding youth. Definition, profile, categories, issues, and challenges of youth; and opportunities for youth who is agent of the social change.
iv. Community mobilization: Mapping of community stakeholders, designing the message asper problems and their culture; finding methods of mobilization involving youth-adult partnership. Social harmony and national integration Indian history and culture, role of youth in nation building, conflict resolution and peace- building. Volunteerism and shramdaan. Indian tradition of volunteerism, its need, importance, motivation, and constraints; shaman as part of volunteerism

Citizenship, constitution, and human rights: Basic features of constitution of India, fundamental rights and duties, human rights, consumer awareness and rights and rights to

information. Family and society. Concept of family, community (PRIs and other community-based organizations) and society

**National Cadet Corps (NCC-1)**

i. National Cadet Corps- 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
ii. Aims, objectives, organization of NCC and NCC song. DG's cardinals of discipline.
iii. Drill- aim, general words of command, attention, stands at ease, stand easy and turning.
iv. Sizing, numbering, forming in three ranks, open and close order march, and dressing.
v. Saluting at the halt, getting on parade, dismissing, and falling out.
vi. Marching, length of pace, and time of marching in quick/slow time and halt. Side pace, paceforward and to the rear. Turning on the march and wheeling. Saluting on the march.
vii. Marking time, forward march, and halt. Changing step, formation of squad and squad drill.
viii. Command and control, organization, badges of rank, honors, and awards
ix. 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.
x. 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.
xi. 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.

## Semester-II

### S0248003 Personality Development 2 (1+1)

**Objective:**
To make students realize their potential strengths, cultivate their inter-personal skills and improve employability.

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

**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.

**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. 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. Pravesh Kumar. 2005. All about Self- Motivation. New Delhi. Goodwill Publishing House.
7. Smith, B. 2004. Body Language. Delhi: Rohan Book Company.
8. Shaffer, D. R. 2009. Social and Personality Development (6th Edition). Belmont, CA: Wadswor.


## S0248004 Environmental Studies and Disaster Management
## 3(2+1)

**Objective:**

To expose and acquire knowledge on the environment and to gain the state-of-the-art - skill and expertise on management of disasters

**Theory:**

**Introduction to Environment -** Environmental studies: Definition, scope and importance - Multidisciplinary nature of environmental studies - Segments of Environment - Spheres of Earth- Lithosphere - Hydrosphere - Atmosphere - Different layers of atmosphere. Natural Resources: Classification - Forest resources. Water resources. Mineral resources Food resources. Energy resources. Land resources. Soil resources. Ecosystems: Concept of an ecosystem - Structure and function of an ecosystem - Energy flow in the ecosystem. Types of ecosystem. Biodiversity and its conservation: Introduction, definition, types. Biogeographical classification of India. Importance and Value of biodiversity. Biodiversity hot spots. Threats and Conservation of biodiversity.

**Environmental Pollution:** Definition, cause, effects and control measures of: a. Air pollution. b. Water pollution. c. Soil pollution. d. Marine pollution. e. Noise pollution. f. Thermal pollution h. Light pollution. Solid Waste Management: Classification of solid wastes and management methods, Composting, Incineration, Pyrolysis, Biogas production, Causes, effects and control measures of urban and industrial wastes. Social Issues and the Environment: Urban problems related to energy. 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.

**Disaster management:** Disaster definition - Types - Natural Disasters - Floods, drought, cyclone, earthquakes, landslides, avalanches, volcanic eruptions, Heat and cold waves. Man MadeDisasters: Nuclear disasters, chemical disasters, biological disasters, building fire, coal fire, forestfire, 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.

**Practical:**

Visit to a local area to document environmental assets river / forest / grassland / hill / mountain. Energy: Biogas production from organic wastes. Visit to wind mill / hydro power / solar power

generation units. Biodiversity assessment in farming system. Floral and faunal diversity assessment in polluted and un polluted system. Visit to local polluted site - Urban/Rural/Industrial/Agricultural to study of common plants, insects and birds. Environmental sampling and preservation. Water quality analysis: pH, EC and TDS. Estimation of Acidity, Alkalinity. Estimation of water hardness. Estimation of DO and BOD in water samples. Estimation of COD in water samples. Enumeration of *E. coli* in water sample. Assessment of Suspended Particulate Matter (SPM). Study of simple ecosystem – Visit to pond/river/hills. Visit to areas affected by natural disaster.

**Suggested Readings:**


1. De, A.K. 2010. Environmental chemistry. Published by New Age International Publishers, New Delhi. ISBN:13–978 81 224 2617 5. 384 pp
2. Dhar Chakrabarti, P.G. 2011. Disaster management - India's risk management policy frameworks and key challenges. Published by Centre for Social Markets (India), Bangalore. 36pp.
3. Erach Bharucha, Textbook 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, US


## S0248005 Soil Fertility Management 3(2+1)

**Objective:**

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

**Theory:**

History of soil fertility and plant nutrition. Criteria of essentiality, role deficiency and toxicity symptoms of essential plant nutrients. Mechanisms of nutrient transport to plants, factors affecting nutrient availability to plants. Chemistry of soil nitrogen, phosphorus, potassium, calcium magnesium, sulphur and micronutrients. Soil fertility evaluation, Soil testing. Critical levels of different nutrients in soil. Forms of nutrients in soil, plant analysis, rapid plant tissue tests. Indicator plants. Methods of fertilizer recommendations to crops STCR/SSNM, Factors influencing nutrient use efficiency (NUE), methods of application under rainfed and irrigated conditions.

Introduction and importance of organic manures, properties and methods of preparation of bulky and concentrated manures. Green/leaf manuring. fertilizer recommendation approaches. Integrated Nutrient management. Chemical fertilizers: classification, composition and properties of major nitrogenous, phosphatic, potassic fertilizers, secondary and micronutrient fertilizers. Complex fertilizers, Nano fertilizers, soil amendments, fertilizer storage, Fertilizer control order. Carbon

sequestration and Carbon Trading. Preparation and properties of major manures (FYM, Composed, Vermicompost, Green Manuring, Oil Cakes).

**Practical:**

Introduction of analytical instruments and their principles, calibration and applications of Coloremetry 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.

**Suggested Readings:**


1. Soil Fertility and Nutrient Management – By S. S. Singh, Kalyani Publishers
2. Soil Fertility and Fertilizers – By Samual 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. ISSS. 2002 Fundamentals of Soil Science. Published by Indian Society of Soil Science, New Delhi
5. Soil Fertility and Nutrient Management-by Rajendra Prasad and YS Shivay, published by NIPA


## S0248006 Fundamentals of Entomology 3(2+1)

**Objectives:**

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

**Theory:**

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. 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. Metamorphosis and diapause in insects. Types of larvae and pupae. Structure and functions of digestive, circulatory, excretory, respiratory, nervous, secretary (Endocrine) and reproductive system, in insects. Types of reproduction in insects. Major sensory organs. Insect Ecology: Introduction, Environment and its components. Effect of abiotic factors and biotic factors. Categories of pests. 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, Lophophidae, Aleurodidae, Pseudococcidae; Neuroptera: Chrysopidae; Lepidoptera: Pieridae, Papiloinidae, Noctuidae, Sphingidae, Pyralidae,

Gelechiidae, Arctiidae, Saturnidae, Bombycidae; Coleoptera: Coccinellidae, Chrysomelidae, Cerambycidae, Curculionidae, Bruchidae, Scarabaeidae; Hymenoptera: Tenthridinidae, Apidae. Trichogrammatidae, lchneumonidae, Braconidae, Chalcididae; 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. Types of insect larvae and pupae; Dissection of digestive system in insects (Grasshopper); Study of characters of orders Orthoptera, Dictyoptera, Odonata, 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.

**Suggested readings:**


1 Fundamentals of Ecology - Eugene. P. Odum and Gray W. Barrett
2 Imm's General Text book of Entomology— O.W. Rechards and R.G. Davies
3 Introduction to the study of Insects –D. J. Borror and DeLong's


## S0248007 Livestock and poultry Management 2(1+1)

**Objectives:**
1 Provide basic knowledge to the students about scientific livestock and poultry rearing practices
2 Entrepreneurship development through Livestock/poultry and Agriculture Integrated FarmingSystem

**Theory:**
Role of livestock in the national economy. Reproduction in farm animals and poultry. Housing principles, space requirements for distinct species of livestock and poultry. Management of calves, growing heifers and milch animals. Management of sheep, goat and swine. Incubation, hatching and brooding. Management of growers and layers. Important Indian and exotic breeds of cattle, buffalo, sheep, goat, swine and poultry. Improvement of farm animals and poultry. Digestion in livestock and poultry. Classification of feed stuffs. Proximate principles of feed. Nutrients and their functions. Feed ingredients for ration for livestock and poultry. Feed supplements and feed additives. Feeding of livestock and poultry. Introduction of livestock and poultry diseases. Prevention (including vaccination schedule) and control of important diseases of livestock and poultry as Common animal diseases of cattle, buffalo, goat, sheep, and swine viz. Anthrax. BQ, HS, Brucellosis, Mastitis, Milk fever, Bloat, Swine fever and Enterotoximea, Vaccination schedule. Vaccination schedule for poultry, Common poultry diseases, i.e. Ranikhet, Marex, Chicken pox, Gumboro, Infectious bronchitis and CRD. Control of internal and external parasites.

**Practical:**
External body parts of cattle, buffalo, sheep, goat, swine and poultry. Handling and restraining of livestock. Identification methods of farm animals and poultry. Visit to IDF and IPF to study breeds of livestock and poultry and daily routine farm operations and farm records. Judging of cattle, buffalo, and poultry. Culling of livestock and poultry. Planning and layout of housing for different types of livestock. Computation of rations for livestock. Formulation of concentrate mixtures. 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

**Suggested Readings:**

1 A Textbook of Animal Husbandry by G. C Banerjee
2 A textbook of Livestock Production management in Tropic by D. N. Verma
3 A textbook of Livestock & Poultry Management, I. J. Johar and R.G. Gupta
4 A textbook of Poultry Science, P.V.S. Vasiha
5 Animal Husbandry & veterinary Science, 15th Edition, D.N. Pandey
6 Handbook of Animal Husbandry 2nd Edition, ICAR

## S0248008 Fundamentals of Plant Pathology 3(2+1)

**Objectives:**

1 To get acquainted with the role of different microorganisms in the development of plant disease
2 To get general concepts and classification of plant diseases
3 To get knowledge of general characteristics of fungi, bacteria, virus, and other microorganismscausing plant diseases
4 To acquaint the students with reproduction in fungi, and bacteria, causing plant diseases
5 To get acquainted with various plant disease management principles and practices

Theory

**Introduction to Plant Pathology:** Concept of disease in plants; Different terms used in Plant Pathology, History of Plant Pathology with special references to India; Causes of plant disease: Inanimate and animate causes; Classification of plant disease; Parasitism and pathogenesis; Development of disease in plants: Disease Triangle, Disease cycle; Fungi and their morphology, reproduction and classification of fungi; Bacteria: Morphology, reproduction classification of phytopathogenic bacteria; Other plant pathogens: Mollicutes; Flagellant protozoa; FVB; Green algae and parasitic higher plants; Viruses and viroids, virus transmission; Principles of Plant disease management: Disease management with chemicals, Host resistance, cultural and biological method of Integrated Disease Management (IDM).

**Practical:**

Study of the microscope; Acquaintance with laboratory material and equipment; Studyof 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.

**Suggested readings:**

1 Agrios, G.N. 2010. Plant Pathology. Acad. Press.
2 Alexopoulos, Mims and Blackwel. Introductory Mycology.
3 Dhingra, O.D. and Sinclair, J.B. 1986. Basic Plant Pathology Methods. CRC Press, London,Tokyo.
4 Gibbs, A. and Harrison, B. 1976. Plant Virology - The Principles. Edward Arnold, London
5 Goto, M. 1990. Fundamentals of Plant Bacteriology. Academic Press, New York.
6 Hull R. 2002. Mathew's Plant Virology. 4th edn. Academic Press, New York.
7 Kamat, M. N. Introductory Plant Pathology. Prakash Pub, Jaipur.
8 Mehrotra, R.S. and Aggarwal, A. 2007. Plant Pathology. 7th edn. Tata Mc Graw Hill Publ. Co.Ltd.
9 Nene, Y.L. and Thapliyal, P.N. 1993. Fungicides in Plant Disease Control. 3rd Ed. Oxford &IBH, New Delhi.
10 Pathak, V. N. Essentials of Plant Pathology. Prakash Pub., Jaipur

11 Rajeev, K. and Mukherjee, R.C. 1996. Role of Plant Quarantine in IPM. Aditya Books.
12 Rhower, G.G. 1991. Regulatory Plant Pest Management. In: Handbook of Pest Management inAgriculture. 2nd edn. Vol. II. (Ed. David Pimental). CRC Press.
13 Singh R.S. 2008. Plant Diseases. 8 th Ed. Oxford & IBH. Pub. Co.
14 Singh R.S. 2013. Introduction to Principles of Plant Pathology. Oxford and IBH Pub. Co.
15 Verma, J.P. 1998. The Bacteria. Malhotra Publ. House, New Delhi.
16 Vyas SC. 1993. Handbook of Systemic Fungicides. Vols. I-III. Tata McGraw Hill, New Delhi.

## S0248009 National Service Scheme (NSS-II) 1(0+1)

i. Importance and role of youth leadership.
ii. Meaning, types and traits of leadership, qualities of good leaders; importance and roles ofyouth leadership, Life competencies.
iii. Definition and importance of life competencies, problem-solving and decision-making interpersonal communication. Youth development Programme.
iv. Development of youth programs and policy at the national level, state level and voluntary sector; youth-focused and youth-led organizations.
v. Health, hygiene and sanitation. Definition needs and scope of health education; role offood, nutrition, safe drinking water, water borne diseases and sanitation (Swachh Bharat Abhiyan) for health; national health programs and reproductive health. Youth health, lifestyle, HIV AIDS and first aid. Healthy lifestyles, HIV AIDS, drugs and substance abuse, home nursing and first aid. Youth and yoga. History, philosophy, concept, myths, and misconceptions about yoga; yoga traditions and its impacts, yoga as a tool for healthy lifestyle, preventive and curative method.

## S0248010 National Cadet Corps (NCC-II) 1 (0+1)

Arms Drill-Attention, stand at ease, stand easy. Getting on parade. Dismissing and falling out. Ground/take up arms, examine arms. Shoulder from the order and vice-versa, present from the order and vice-versa. Saluting at the shoulder at the halt and on the march. Short/ long trail from the order and vice- versa. Guard mounting, guard of honor, Platoon/CoyDrill.

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.

i. 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.
ii. Introduction to map, scales, and conventional signs. Topographical forms and technical terms.
iii. 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.
iv. 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/withoutarms. Section battle drill. Types of communication, media, latest trends and developments.

## Semester III

## S0348002 Entrepreneurship Development and Business Communication 3 (2+1)

**Objective:**

1. To provide student an insight into the concept and scope of entrepreneurship
2. To expose the student to various aspects of establishment and management of a small businessunit
3. To enable the student to develop financially viable agribusiness proposal

**Theory:**

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, importanceof entrepreneurial development, and process of entrepreneurship development. Environment scanning and opportunity identification need for scanning: spotting of opportunity, scanning of 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 functioning of an enterprise. Selection of the product / services, selection of form of ownership; registration, selection of site, capital sources, acquisition of manufacturing know how, packaging and distribution. Planning of an enterprise, project identification, selection, and formulation of project; project report preparation, Enterprise Management. Production management: product, levels of products, product mix, quality control, cost of production, production controls, Material management. Production management: raw material costing, inventory control. Personal management: manpower planning, labour turn over, wages / salaries. Fiscal management /accounting: funds, fixed capital and working capital, costing and pricing, long term planning and short-term planning, book keeping, journal, ledger, subsidiary books, annual financial statement, taxation. Marketing management: market, types, marketing assistance, market strategies. Crisis management: raw material, production, leadership, market, finance, natural etc.

**Practical:**

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

**Suggested Readings:**


1. Charantimath, P.M. 2009, Entrepreneurship Development and Small Business Enterprises.Pearson Publications, New Delhi.
2. Desai, V. 2015, Entrepreneurship: Development and Management, Himalaya Publishing House.
3. Gupta, C.B. 2001. Management Theory and Practice. Sultan Chand & Sons.
4. Indu Grover. 2008. Handbook on Empowerment and Entrepreneurship. Agrotech Public Academy.
5. Khanka, S.S. 1999. Entrepreneurial Development. S. Chand & Co.
6. Mehra, P. 2016, Business Communication for Managers. Pearson India, New Delhi.
7. Pandey, M. and Tewari, D. 2010, The Agribusiness Book. IBDC Publishers, Lucknow.
8. Singh, D. 1995. Effective Managerial Leadership. Deep & Deep Publ.
9. Singhal, R.K. 2013, Entrepreneurship Development & Management, Katson Books.
10. Tripathi, P.C. and Reddy, P.N. 1991. Principles of Management. Tata McGraw Hill.
11. Vasant Desai, 1997. Small Scale Industries and Entrepreneurship. Himalaya Publ. House


## S034803 Physical Education, First Aid, Yoga Practices and Meditation 2 (0+2)

**Objectives:**

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, perform first aid andincrease stamina and 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.

**Yoga; History of Yog, Types of Yog, Introduction to Yog,**

i. Asanas (Definition and Importance) Padmasan, Vajrajasan, Shashankasan, Pashchimotasan, Ushtrasan, Tadasan, Padhastasan, Ardhchandrasan, Bhujangasan, Utanpadasan, Sarvangasan, Parvatasan, Patangasan, Shishupalanasan – left leg-right leg, Pavanmuktasan, Halasan, Sarpasan, Ardhdhanurasan, Sawasan.
ii. Suryanamskar Pranayama (Definition and Importance) Omkar, Suryabhedan, Chandrabhedan, AnulomVilom, Shitali, Shitkari, Bhastrika, Bhramari.
iii. Meditation (Definition and Importance), Yogic Kriyas (Kapalbhati), Tratak, Jalneti and Tribandh
iv. Mudras (Definition and Importance) Gyanmudra, Dhyanmudra, Vayumudra, Akashmudra, Pruthvimudra, Shunyamudra, Suryamudra, Varunmudra, Pranmudra, Apanmudra, Vyanmudra, Uddanmudra
v. Role of yoga in sports
vi. Teaching of Asanas – demonstration, practice, correction and practice.

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, firstaid 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. Firstaid 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.

## S0348004 Principles of Genetics 3(2+1)

**Objective:**

To make the students acquainted with both principles and practices in the areas of classical genetics, modern genetics, quantitative genetics and cytogenetics.

**Theory:**

Pre and post Mendelian concepts of heredity, Mendelian principles of heredity, Study of model organisms (Drosophila, Arabidopsis, Garden pea, *E. coli*, and mice), Architecture of chromosomes, chromonemata, chromosome matrix, chromomeres, centromere, secondary constriction and telomere, special types of chromosomes, Chromosomal theory of inheritance- cell cycle and cell division-mitosis and meiosis. Probabilit and Chi-square. Types of DNA and RNA, Dominance relationships, Epistatic interactions with example, Introduction and definition of cytology, genetics and cytogenetics and their interrelation.

Multiple alleles, pleiotropism and pseudo alleles, Sex determination and sex linkage, sex limited and sex influenced traits, Blood group genetics, Linkage and its estimation, crossing over

mechanism, chromosome mapping, Structural and numerical variations in chromosomes and their implications, Use of haploids, dihaploids and double haploids in Genetics, Mutation, classification, Methods of inducing mutations, mutagenic agents and induction of mutation. Qualitative and quantitative traits, Polygenes and continuous variations, multiple factor hypothesis, Cytoplasmic inheritance, Nature, structure and replication of genetic material, Protein synthesis, Transcription and translational mechanism of genetic material, Gene concept: Gene structure, function and regulation.

**Practical:**

Study of microscope, Study of cell structure, Mitosis and Meiosis cell division, Experiments on monohybrid, dihybrid, trihybrid, test cross and back cross, Experiments on epistatic interactions including test cross and back cross, Practice on mitotic and meiotic cell division, Experiments on probability and chi-square test, Determination of linkage and croo-over analysis (through two point test cross data), Study on sex linked inheritance in Drosophila. Study on models on DNA and RNA structures.

**Suggested readings:**


1. Fundamentals of Genetics: B. D. Singh
2. Genetics: M. W. Strickberger.
3. Principles of Genetics: Gardner, Simmons and Snustad.
4. Principles of Genetics: Sinnott, Dunn and Dobzhansky


## S0348005 Crop Production Technology-I (*Kharif* crops) 3 (2+1*)

**Objectives:**

To impart basic and fundamental knowledge on principles and practices of kharif crop production

To impart knowledge and skill on scientific crop production and management

**Theory:**

Origin, geographical distribution, economic importance, soil and climatic requirements,varieties, cultural practices and yield of *Kharif* crops. Cereals- rice, maize, sorghum, pearl millet, finger millet and other minor millets, pulses- pigeonpea, mungbean and urdbean; oilseeds- groundnut, soybean, sesame, castor; fibre crops- cotton and jute; forage crops- sorghum, cowpea, cluster bean, maize, guinea and napier.

**Practical:**

Rice nursery preparation, transplanting of rice, sowing of soybean, pigeon pea and mungbean, 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.

## S348010 *Practical Crop Production- 1(0+1)

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

**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 ICARPublication.
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.

## S0348006 Production Technology of Fruit and Plantation Crops 2 (1+1)

**Objectives:**

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 offruit and plantation crops
3. To educate about the physiological disorders of fruit crops, palms and plantation crops

**Theory:**

**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. Crop production techniques in tropical, sub-tropical and temperate fruit crops: Climate and soil requirements, varieties, propagation and use of rootstocks, planting density and systems of planting: High density and ultra-high-density planting, cropping systems, after care – training and pruning; water, nutrient and weed management, fertigation, special horticultural techniques, plant growth regulation, important disorders, maturity indices and harvest, value addition.

**Fruit crops:** mango, banana, papaya, guava, sapota, citrus, grape, litchi, pineapple, pomegranate, apple, pear, peach, strawberry, nut crops Jackfruit and minor fruits- date, ber, apple, plantation crops-coconut, arecanut, cashew, tea, coffee and rubber.

Crop production techniques in palms and 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 and Palmyrah, Plantation crops: Tea, Coffee, Cocoa, Cashewnut, Rubber.

**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.

**Suggested Readings:**

1. Banday, F.A. and Sharma, M.K.2010 Advances in temperate fruit production. Kalyani Publishers, Ludhiana
2. Bose, T.K., S.K. Mitra and D. Sanyal 2001. Fruits: Tropical and Subtropical (2 volumes) Naya Udyog, Calcutta.
3. Bose, T.K., S.K. Mitra, A.A. Farooqi and M.K. Sadhu (Eds). 1999. Tropical Horticulture Vol.1. Naya Prokash, Calcutta.
4. Chadha, K.L. 2001. Handbook of Horticulture. ICAR, Delhi
5. Chadha, T.R. 2001 Textbook of temperate fruits. ICAR, New Delhi
6. Chattopadhyay, T.K. 2001. A Text Book on Pomology (4 volumes). Kalyani Publishers, Ludhiana.

7. Chattopadhyay. 1998. A textbook on pomology (sub-tropical fruits) vol.III. Published by M/s. Kalyani publishers, Ludhiana, New Delhi, Noida. UP.
8. Chudawat, B. S.1990. Arid fruit culture Oxford &IBH, New Delhi
9. Das, B.C. and Das S.N. Cultivation of minor fruits. Kalyani Publishers, Ludhiana
10. David Jackson and N.E. Laone, 1999. Subtropical and temperate fruit production. CABI publications
11. H.P. Singh and M.M. Mustafa 2009. Banana-new innovations Westville publishing House, New Delhi
12. Kumar, N. 1997. Introduction to Horticulture. Rajalakshmi Publications, Nagercoil, Tamil Nadu.
13. Mitra, S.K., T.K. Bose and D.S. Rathore. 1991. Temperate fruits. Horticulture and allied Publishers, Calcutta.
14. Pal, J.S. 1997. Fruit Growing. Kalyani Publishers, New Delhi.
15. Radha, T. and Mathew, L.2007. Fruit crops. New India publishing Agency
16. Rajput, CBS and Srihari babu, R.1985. Citriculture, Kalyani Publishers, Ludhiana
17. Sadhu, M.K. and P.K. Chattopadhyay. 2001. Introductory Fruit Crops. Naya Prokash, Calcutta.
18. Singh, S.P. 2004. Commercial Fruits. Kalyani Publishers, Ludhiana
19. Symmonds. 1996. Banana, II Edn.Longman, London
20. Veeraragavathatham, D., Jawaharlal, M., Jeeva, S., Rabindran, R and Umapathy, G. 2004 (2nd edition). Scientific fruit culture. Published by M/s. Suri associates, 1362/4, Velraj Vihar Complex, Thadagam Road, Coimbatore- 2
21. W.S. Dhillon. 2013. Fruit production in India. Narendra publishing House, New Delhi
22. Kavino, M, V. Jegadeeswari, R. M. Vijayakumar and S. Balkrishnan. 2018. Production Technology of Fruits and Plantation Crops by Narendra Publishing House.
23. Kumar, N.J. B.M. Md. Abdul Khaddar, Ranga Swamy, P. and Irulappan, I. 1997. Introduction to spices, Plantation crops and Aromatic plants. Oxford & IBH, New Delhi.
24. Nair. 1979. Cashew, CPCRI, Kerela
25. Sharma, A., Kumar, P., Tripathi, V.K. 2024. Production Technology of Fruits and Plantation Crops. Elite Publishing House
26. Thampan, P.K.1981. Handbook of coconut palm. Oxford &IBH, New Delhi.
27. Thompson, P.K.1980. Coconut. Oxford &IBH, New Delhi
28. V. Ponnuswami, M. Kumar; S. Ramesh Kumar and C. Krishnamoorthy 2015. Fruit and Plantation Crops Narendra Publishing House.

## S0348007 Fundamentals of Extension Education 2 (1+1)

**Objectives:**

1. State the importance of extension education in agriculture
2. Familiarize with the different types of agriculture and rural development programs launchedby govt. of India
3. Classify the types of extension teaching methods
4. Elaborate the importance and different models of communication
5. Explain the process and stages of adoption along with adopters' categories

**Theory:**

Education: Meaning, definition and Types; Extension Education: meaning, definition, scopeand process; objectives and principles of Extension Education; Extension Programme planning: Meaning, Process, Principles and Steps in Programme Development. 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. New trends in agriculture extension: privatization extension, cyber extension/ e-extension, market-led extension, farmer-led extension, expert systems,

etc., Attributes of Innovation, DWCRA, Commodity Interest Groups (CIGs)., Farmers Producer Group (FPG).

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; extension teaching methods: meaning, classification, individual, group and mass contact methods, ICT Applications in TOT (New and social media), media mix strategies; communication: meaning and definition; Principles and Functions of Communication, models and barriers to communication. Agriculture journalism; diffusion and adoption of innovation: concept and meaning, process and stages of adoption, adopter categories.

**Practical:**

To get acquainted with university extension system. Group discussion- exercise; Identification of rural leaders in village situation; preparation and use of AV aids, preparation of extension literature (leaflet, booklet, folder, pamphlet news stories and success stories); Presentation skills exercise; micro teaching exercise; A visit to village to understand the problems being encountered by the villagers/ farmers; to study organization and functioning of DRDA/PRI and other development departments at district level; visit to NGO/FO/FPO 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.

**Suggested readings:**


1. Adivi Reddy, A. 2001. Extension Education, Sree Lakshmi press, Bapatla.
2. Dahama, O. P. and Bhatnagar, O.P. 1998. Education and Communication for Development,Oxford and IBH publishing Co. Pvt. Ltd, New Delhi.
3. Jalihal, K. A. and Veerabhadraiah, V. 2007. Fundamentals of Extension Education andManagement in Extension, Concept publishing company, New Delhi.
4. MuthaiahManoraharan, P. and Arunachalam, R., Agricultural Extension, Himalaya PublishingHouse (Mumbai).
5. Sagar Mondal and Ray, G. L., Text Book on Rural Development, Entrepreneurship andCommunication Skills, Kalyani Publications.
6. Rathore, O. S. et al. 2012. Handbook of Extension Education, Agrotech Publishing Academy,Udaipur.
7. Dudhani, C.M., Hirevenkatgoudar, L.V., Manjunath, L. Hanchinal, S.N. and Patil, S.L. 2004.Extension Teaching Methods and Communication Technology, UAS, Dharwad.
8. Sandhu, A.S. 1993. Text book on Agricultural Communication: Process and Methods. Oxfordand IBH Publishing Pvt. Ltd, New Delhi.
9. Singh, A.K., Lakhan Singh, R. and Roy Burman. 2006. Dimensions of Agricultural Extension.Aman Publishing House, Meerut


## S0348008 Fundamentals of Nematology
## 2(1+1)

**Objectives:**

To impart knowledge on history, economic importance of plant parasitic nematodes,morphology, biology, host parasitic relationship of nematodes.

To impart knowledge on nematode pests of different crops of national and local importanceand their management.

**Theory:**

Introduction: History of phytonematology, habitat and diversity, economic importance of nematodes. General characteristics of plant parasitic nematodes. Nematode: definition, general morphology and biology. Classification of nematodes up to family level with emphasis on groups containing economically important genera. Classification of nematodes on the basis of feeding/ parasitic habit. Symptomatology, role of nematodes in disease development, Interaction between plant parasitic nematodes and disease-causing fungi, bacteria and viruses. Nematode pests of crops: Rice, wheat, vegetables, pulses, oilseed and fiber crops, citrus and banana, tea, coffee and coconut. Different methods of nematode management: Cultural methods, physical; methods, biological methods, Chemical methods, Plant Quarantine, Plant resistance and INM.

**Practical:**

Sampling methods, collection of soil and plant samples; Extraction of nematodes from soil and plant tissues following Cobb's sieving and decanting technique, Baermann funnel technique, Picking and counting of plant parasitic nematode. Identification of economically important plant nematodes up to generic level with the help of keys and description: Meloidogyne, Pratylenchus; Heterodera, Tylenchulus, Xiphinema, and Helicotylenchus etc. Study of symptoms caused by important nematode pests of cereals, vegetables, pulses, plantation crops etc. Methods of application of nematicides and organic amendments.

**Suggested readings:**


1. Economic Nematology-Edited by J.M. Webster
2. Plant Parasitic Nematodes (Vol-1) by Zukerman, Mai, Rohde
3. Plant Parasitic Nematodes of India: Problems and Progress by - Gopal Swarup, D. R. Dasgupta, P. K. Koshy.
4. Text book on Introductory Plant Nematology -R.K. Walia and H.K. Bajaj.


## S0348009 Principles and Practices of Natural Farming 2 (1+1)

**Objectives:**

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 undernatural farming.
3. To impart practical knowledge of natural farming and related agricultural practices in Indianand global environmental and economic perspectives.

**Theory:**

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

**Practical:**

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

**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/i9037 en/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. Agroeeological 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 Telengana), 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. Shamasastry, 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.

**S0348011 Chemistry of Dairy Products 2(1+1)**

**Objectives**

1. To know about the composition and legal standards for different types of dairy products

2. Understanding the effect of process variables on physico-chemical changes during manufacture of dairy products

**Theory**

Chemical composition and legal standards of milk products. Chemistry of creaming and factors affecting the same. Ripening and neutralization of cream. Theories of churning and factors affecting the same. Butter colour. Ghee: Physico-chemical changes during manufacture. Hydrolytic and oxidative deterioration, their causes, prevention and role of antioxidants. Physico-chemical changes in milk constituents during manufacture and storage of traditional dairy products: Khoa, Paneer, Dahi, Channa, Lassi, Chakka, Shrikhand. Chemistry of cheese: milk clotting enzymes, enzymatic coagulation of milk, biochemical changes during ripening. Physico-chemical changes during preparation and storage of concentrated and dried milk products. Physico-chemical changes during processing and storage of ice cream and frozen desserts. Role and mechanism of stabilizers and emulsifiers in ice cream.

**Practical**

*Cream*: estimation of fat and acidity; *Butter*: estimation of fat, moisture, curd and salt content; *Ghee*: estimation of moisture, acid value, Butyro refractive reading and Reichert Meissl value / Polanske value; Determination of lactose and sucrose in *sweetened condensed milk*; Milk powder: moisture, fat, solubility, and acidity; *Ice cream*: estimation of fat and total solids; Estimation of moisture, fat and salt content in *cheese*; Khoa/paneer: estimation of moisture and fat.

**Suggested reading**

1. Fox, P. F. (Ed). (2006). Developments in Dairy Chemistry. Applied Sci. Publ., NewYork.
2. Jenness, R. and Patton, S. (1984). Principles of Dairy Chemistry. Wiley Eastern Pvt. Ltd, New Delhi.
3. Mathur, M. P., Datta, D. R., and Dinakar, P. (1999). Text book of Dairy Chemistry, Directorate of Information and Publs., ICAR, New Delhi.
4. Webb, B. H., Johonson, A. H., and Alford, J. A. (Eds). (2008). Fundamentals of Dairy Chemistry. CBS Publ. and Distributors Pvt. Ltd., New Delhi.

# Semester IV

## S0448002 Agricultural Informatics and Artificial Intelligence (AI) 3(2+1)

**Objective:**

1. To acquaint student with the basics of computer applications in agriculture, multimedia, database management, application of mobile app and decision- making processes, etc.
2. To provide basic knowledge of computer with applications in Agriculture
3. To make students familiar with Agricultural-Informatics, its components and applications inagriculture

**Theory:**

Introduction to Computers, Anatomy of Computers, Memory Concepts, Units of Memory, Operating System: Definition and types, Applications of MS-Office for creating, Editing and Formatting a document, Data presentation, Tabulation and graph creation, Statistical analysis, Mathematical expressions, Database, concepts and types, creating data base, Uses of DBMS in Agriculture. Internet and World Wide Web (WWW): Concepts and components. Computer programming: General concepts, Introduction general programming concepts. Concepts and standard input/output operations. e-Agriculture, Concepts, design and development, Application of innovative ways to use information and communication technologies (IT) in Agriculture. Computer Models in Agriculture: Statistical, weather analysisand crop simulation models, concepts, inputs-outputs files, limitation, advantages and application of models for understanding plant processes, sensitivity, verification, calibration and validation,IT applications for computation of water and nutrient requirement of crops, Computer-controlled devices (automated systems) for Agri-input management. Smartphone mobile apps in agriculture for farm advice: Market price, post-harvest management etc. Geospatial technology: Concepts, techniques, components and uses for generating valuable agri-information. Decision support systems: Concepts, components and applications in Agriculture. Agriculture Expert System, Soil Information Systems etc., for supporting farm decisions. Preparation of contingent crop-planning and crop calendars using IT tools. Digital India and schemes to promote digitalization of agriculture in India. Introduction to artificial intelligence, background and applications, Turing test. Controlstrategies, Breadth-first search, Depth-first search, Heuristics search techniques: Best-first search, A* algorithm, IoT and Big Data; Use of AI in agriculture for autonomous crop management, and health, monitoring livestock health, intelligent pesticide application, yield mapping and predictive analysis, automatic weeding and harvesting, sorting of produce, and other food processing applications; Concepts of smart agriculture, use of AI in food and nutrition science etc.

**Practical:**
Study of computer components, accessories, practice of important DoS Commands, Introduction of different operating systems such as Windows, Unix/Linux, creating files and folders, File Management .Use of MS-Word and MS Power-point for creating, editing and presentinga scientific documents, MS-EXCEL-Creating a spreadsheet, Use of statistical tools, Writing expressions, Creating graphs, Analysis of scientific data, MS-ACCESS: Creating Database, preparing queries and reports, Demonstration of Agri- information system, Introduction to World Wide Web (WWW) and its components, Introduction of programming languages such as Visual Basic, Java, Fortran, C, C++, Hands on practice on Crop Simulation Models (CSM), DSSAT/Crop-Info/Crop Syst/ Wofost, Preparation of inputs file for CSM and study of model outputs, computation of water and nutrient requirements of crop using CSM and IT tools, Use of smartphones and other devices in agro-advisory and dissemination of market information, Introduction of Geospatial technology, AR/ VR demonstration, Preparation of contingent crop planning, India Digital Ecosystem of Agriculture (IDEA).

**Suggested Readings:**


1. Concepts and Techniques of Programming in C by Dhabal Prasad Sethi and Manoranjan, Wiley India.
2. Fundamentals of Computer by V. Rajaroman.
3. Introduction to Information Technology by Pearson.
4. Introduction to Database Management System by C. J. Date.
5. Introductory Agri-Informatics by Mahapatra, Subrat K et al, Jain Brothers Publication.


## S0448003 Production Technology of Vegetables and Spices 2(1+1)

**Objectives:**
1. To educate about the different forms of classification of vegetables
2. To educate about the origin, area, climate, soil, improved varieties and cultivation practices ofvegetables and spices
3. To educate about the physiological disorders of vegetables and spices

**Theory:**

Importance of vegetables and spices in human nutrition and national economy, kitchen gardening, brief about origin, area, climate, soil, improved varieties and cultivation practices such as time of sowing, transplanting techniques, planting distance, fertilizer requirements, irrigation, weed management, harvesting and yield, physiological disorders of important vegetable and spices (tomato, okra, brinjal, chili, capsicum, cucumber, bitter gourd , bottle gourd, sweet potato, cassava and moringa, pumpkin, French bean, peas; cole crops such as cabbage, cauliflower, knol-khol; bulb crops such as onion, garlic; root crops such as carrot, radish, beetroot; tuber crops such as potato; leafy vegetables such as amaranth, palak, perennial vegetables, spice crops like turmeric, zinger, garlic, coriander, cumin, black pepper, cardamom, fenugreek, fennel, clove, nutmeg, cinnamon, curry leaf, tamarind and herbal spices).

**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 garden.

**Suggested readings:**


1. Olericulture, Fundamentals of Vegetable Production (Vol.1) by K.P. Singh, Anant Bahadur
2. Vegetable crops by J. Kabir, T.K. Bose, M.G. Som
3. Vegetable crops (Production technology, Vol II) by M.S. Fagaria, B.R. Choudhury, R.S. Dhaka


## S0448004 Principles of Agricultural Economics and Farm Management 2(2+0)

**Objectives:**

1. To aware the students about broad areas covered under agricultural Economics and farmmanagement
2. To impart knowledge on judicious use of resources for optimum production

**Theory:**

Economics: Meaning, scope and subject matter, definitions, activities, approaches to economic analysis; micro- and macro-economics, positive and normative analysis. Nature of economic theory; rationality assumption, concept of equilibrium, economic laws as generalization of human behavior. Basic concepts: Goods and services, desire, want, demand, utility, cost and price, wealth, capital, income and welfare. Agricultural economics: meaning, definition, characteristics of agriculture, importance and its role in economic development. Agricultural planning and development in the country. Demand: meaning, law of demand, demand schedule and demand curve, determinants, utility theory; law of diminishing marginal utility, equi-marginal utility principle. Consumer's equilibrium and derivation of demand curve, concept of consumer surplus. Elasticity of demand: concept and measurement of price elasticity, income elasticity and cross elasticity. Production: process, creation of utility, factors of production, input output relationship. Laws of returns: Law of variable proportions and law of returns to scale. Cost: Cost concepts, short run and long run cost curves. Supply: Stock v/s supply, law of supply, supply schedule, supply curve, determinants of supply, elasticity of supply. Distribution theory: meaning, factor market and pricing of factors of production. Concepts of rent, wage, interest and profit. National income: Meaning and importance, circular flow, concepts of national income accounting and approaches to measurement, difficulties inmeasurement. Population: Importance, Malthusian and Optimum population theories, natural and socio-economic determinants, current policies and programs on population control. Money: Barter system of exchange and its problems, evolution, meaning and functions of money, classification ofmoney, money supply, general price index, inflation and deflation. Economic systems: Conceptsof economy and its functions, important features of capitalistic, socialistic and

mixed economies, elements of economic planning. Forms of business organizations, international trade and balance ofpayments. GST and its implication on Indian economy.

**Suggested Readings:**


1. Johl, S.S. and T.R Kapur. 2009. Fundamentals of Farm Business Management. Kalyani Publishers
2. S. Subha Reddy, P. Raghu Ram, T.V. Neelakanta and I. Bhvani Devi .2004. Agricultural Economics. Oxford & IBH publishing Co. Pvt. Ltd


## S0448005 Crop Production Technology-II (*Rabi* Crops) 3(2+1)

**Objectives:**

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.

**Theory:** Origin, geographical distribution, economic importance, soil and climaticrequirements, varieties, cultural practices and yield of *Rabi* crops. Cereals- wheat and barley. Pulses-chickpea, lentil, peas. *Rabi* redgram and, rajmash. Oilseed- rapeseed, mustard, sunflower, safflower; and linseed. Sugar crops-sugarcane and sugar beet. Medicinal and aromatic crops- mentha, lemon grass and citronella. Forage crops –barseem, lucerne and oat; potato, quinoa, tobacco.

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; oil extraction of medicinal crops; visit to research stations of related crops.

## S0448010 * Practical Crop Production- 1(0+1)

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

**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 ICARPublication.
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.


## S0448006 Farm Machinery and Power 2(1+1)

**Objectives:**

To enable the students to understand the need of farm power, basic principles and parts of IC engine, different tillage, sowing, intercultural, plant protection equipment, working principles of threshers, harvesting of field and horticultural crops.

**Theory:**
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; Familiarization with different systems of I.C. engines: Air cleaning, cooling, lubrication, fuel supply and hydraulic control system of a tractor; Familiarization with Power transmission system : clutch; gear box, differential and final drive of a tractor; Tractor types; Cost analysis of tractor power and attached implement; Criteria for selection of tractor and machine implements. Familiarization with Primary and Secondary Tillage implement; Implement for hill agriculture; 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.

**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.

**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. Jha, 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


## S0448007 Water Management 2 (1+1)

**Objectives:**
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 andhorticultural crops and drainage.
3. To study the soil moisture conservation practices including management of rain water, watershed and command areas.

**Theory:**
Irrigation: definition and objectives; Importance: Function of water for plant growth, water resources and irrigation development for different crops in India; Soil plant water relationships; Available and unavailable soil moisture, distribution of soil moisture, water budgeting, rooting characteristics, moisture extraction pattern, effect of moisture stress on crop growth. Methods of soil moisture estimation, evapotranspiration and crop water requirement; effective rainfall, different approaches of scheduling of irrigation; Methods of irrigation: surface and sub-surface, pressurized methods, viz., sprinkler and drip irrigation, their suitability, merits and limitations, fertigation,

economic use of irrigation water; Layout of different irrigation systems, Irrigation efficiency and water use efficiency, conjunctive use of water, irrigation water quality and its management. Water management of different crops (rice, wheat, maize, groundnut, sugarcane, mango, banana and tomato); quality of irrigation water, irrigation management practices for different soils and crops, drip, sprinkler. Layout of underground pipeline system, Irrigation automation, Artificial Intelligence and climate-based irrigation practices and its management.

**Practical:**
Determination of bulk density by field method; Determination of soil moisture content by gravimetric method, tensiometer, electrical resistance block and neutron moisture meter; 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 (Problems); Determination of infiltration rate; Demonstration of furrow method of irrigation; Demonstration of check basin and basin method of irrigation; Visit to farmers' field and cost estimation of drip irrigation system; Demonstration of filter cleaning, fertigation, injection and flushing of laterals; layout for different methods of irrigation, Erection and operation of sprinkler irrigation system; Measurement of emitter discharge rate, wetted diameter and calculation of emitter discharge variability; Visit to irrigation research centre/ station and visit to command area.

**Suggested Readings:**


1. Rao, Y.P. and Bhaskar, S.R. Irrigation technology. Theory and practice. Agrotech publishing Academy, Udaipur.
2. Dilipkumar Mujmdar. Irrigation water management: Principles and Practices. Prentice Hall ofIndia Pvt. Ltd.,
3. S.V. Patil &Rajakumar, G. R., Water Management in Agriculture and Horticultural Crops. Satish serial publishing House, Delhi.
4. Carr M. K. V. and Elias Fereres. Advances in Irrigation Agronomy. Cambridge UniversityPress.
5. Michael, A.M. Irrigation Theory and practice. Vikas publishing house Pvt, Ltd.


## S0448008 Problematic Soils and their Management 2(1+1)

**Objectives:**
To acquaint the students about various problem soils like acid soils, degraded soils, saline soils, alkali soils, submerged soils, polluted soils. Reclamation of problem soils by using Multipurpose trees (MPTs)
To give hands on training about estimation of various soil and water quality parameters associated with problem soils.

**Theory:**
Soil quality and health, Distribution of Waste land and problem soils in India, Categorization of Problem soils based on properties. Reclamation and management of Acid soils, Saline, Sodic soils, Acid Sulphate soils, Eroded and Compacted soils, polluted soils. Contaminated soils (Pesticide contamination, Heavy metal contamination), Mined soils (Coal mined, Oil mined), Management of Riverine soils, Water logged soils, Irrigation water–quality and standards, utilization of saline water in agriculture. 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.

**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.

**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 Delhi.
3. CirsanJ.Paul.,1985,. Principles of Remote Sensing. Longman, NewYork
4. Indian Society of Soil Science.,2002. Fundamentals of Soil Science. IARI, New Delhi.
5. Osman, Khan To whid.,2018., Management of Soil Problems. Springer publication
6. Srivastava,V.C.,2002.Management of Problem Soils-Principles and Practices New D


## S0448009 Basics of Plant Breeding 3 (2+1)

**Objectives:**

To acquaint with different techniques ranging from simply selecting plants with desirable characteristics for propagation, to more complex molecular techniques for breeding new varieties, which are higher yielding, resistant to biotic and abiotic stresses for ensuring food security.

**Theory:**

Historical development, concept, nature and role of plant breeding, major achievements and future prospects; Genetics in relation to plant breeding, modes of reproduction and apomixes, self-incompatibility and male-sterility-genetic consequences, cultivar options, Plant genetic resources, its utilization and conservation Domestication, Acclimatization and Introduction. Centres of origin/diversity, Components of Genetic variation. Heritability and genetic advance. Pre-breeding and Universal Plant Breeder's equation. Genetic basis and breeding methods in self-pollinated crops- mass and pure line selection, hybridization techniques and handling of segregating population. Multiline concept, Concepts of population genetics and Hardy-Weinberg Law, Genetic basis and methods of breeding cross-pollinated crops, modes of selection. Population movement schemes- Ear to Row method, Modified Ear to Row, recurrent selection schemes. Heterosis and inbreeding depression, development of inbred lines and hybrids, composite and synthetic varieties. Breeding methods in asexually propagated crops, clonal selection and hybridization. Wide hybridization and pre-breeding. Polyploidy in relation to plant breeding, mutation breeding-methods and uses. Breeding for important biotic and abiotic stresses. Participatory plant breeding. Variety Release and notification. Intellectual Property Rights, Patenting, Plant Breeders and Farmer's Rights.

**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.

**Suggested Readings:**


1 Principles of Plant Breeding (1st & 2nd Edition) by RW Allard.

2 Plant Breeding: Principles & Practices by JR Sharma.
3 Plant Breeding- B.D. Singh.
4 Principles and Procedures of Plant Breeding - Biotechnical and Conventional Approaches byGS Chahal and SS Gosal.
5 Principles of Plant Genetics and Breeding by George Acquaah.

## S0448011 Beneficial Insects & Pests of Horticultural Crops & their Management 2(1+1)

**Course Objective:** To equip students with knowledge and skills for identifying and managing beneficial insects and pests in horticultural crops, while also understanding the role of beneficial insects in sustainable pest control and crop production.

**Theory:**

Importance of beneficial insects in Agriculture, Honeybee, Silkworm, Lac insects, Bioagents as natural enemies, Various Institutes related to beneficial insects. Apiculture: Introduction and history of Beekeeping, Bee keeping, morphology and anatomy, bee biology, Pollinating plants and their cycle, bee conservation, Commercial methods of bee rearing, equipment used, seasonal management of bees, Bee hives and their description, Bee pasturage, bee foraging, behaviour and communication. Enemies-Insect pests and diseases of honey bee and their Management. Sericulture: Related terminologies, History and development of silkworms in India, types of silkworm, voltinism and biology of silkworm, Mulberry cultivation, crop varieties, method of harvesting and preservation of mulberry leaves, Rearing house and rearing appliances of mulberry silkworm, methods of disinfection and hygiene, Silkworm rearing, mounting, harvesting and marketing of cocoons, Pest and diseases of silkworm and their management. Lac culture**:** Species of lac insect, morphology, biology, behaviour, host plants, Lac production and its uses, Types of lac- seed lac, button lac, shellac, and lac-products Biocontrol agents. Natural Enemies: Introduction of bioagents, Ideal characteristics of bioagents, Successful examples of biological Control, General classification: Important insect orders bearing predators and parasitoids used in pest control, Identification of major parasitoids and predators commonly used in biological control of crop pests. Major parasitoids: *Trichogramma* sp., *Chelonus blackburni*, *Cotesia (Apanteles)* sp., *Bracon* sp., *Epiricania melanoleuca*, *Goniozus nephantidis*, *Campoletis chloridae*, Major predators: *Chrysoperla* sp., Australian lady bird beetle- *Cryptolaemus montrouzieri* Weed killers: *Zygogramma bicolorata*, *Neochetina* spp. Mass multiplication and field release techniques of some important parasitoids: *T. chilonis*, *Chelonus blackburni*, *Cotesia / Bracon*, *Goniozus nephantidis*, *Epiricania melanoleuca* Mass multiplication and field release techniques of important predators: *Chrysoperla* sp., Australian lady bird beetle, Weed predators/killers: *Zygogramma bicolorata*, *Neochetina* sp. Important species of pollinator and scavengers with their Importance.

**Practical:**

Studies on honey bee colony: Bee species and castes of bees. Bee keeping appliances and seasonal management. Bee enemies and diseases. Bee pasturage, bee foraging and communication. Types of silkworm, voltinism and biology of mulberry silkworm. Mulberry cultivation, mulberry varieties and methods of harvesting of leaves. Rearing of mulberry silkworm on artificial diet / natural mulberry leaves

Studies on strains / species of lac insect, host plant and their identification. Identification of other important pollinators and scavengers. Mass production of host insect- Corcyra cephalonica St. Mass multiplication of parasitoids: *Trichogramma chilonis*, *Chelonus blackburnii*, *Goniozus nephantidis*. Mass multiplication of predators: *Chrysoperla sp*. And Australian lady beetle-*Cryptolaemus montrouzieri Mulsant.* Visit to research and training Institution/Unit of Beekeeping, Sericulture, Lac culture and Bioagent production units.

**Suggested readings:**

1. **Atwal, A.S. 1976.** Agricultural Pests of India and South East Asia. Kalyani Publishers, Ludhiana.

2. **Butani, D.K. and Jotwani, M.G. 1984.** Insects in Vegetables. Periodical Export Book Agency,New Delhi.
3. **Butani, D. K. 1984.** Insects and Fruits. Periodical Export Book Agency, New Delhi.
4. **Dennis S Hill 1987** Agricultural Insect Pests of tropics and their control, Cambridge Universtiy Press , New York
5. **Khare, S.P. 1993.** Stored Grain Pests and Their Management. Kalyani Publishers, Ludhiana.
6. **Nair MRGK. 1986.** Insects and Mites of crops in India. Indian Council of Agricultural Research New Delhi.
7. **Ramakrishna Ayyar, T.V. 1963.** Handbook of Economic Entomology for South India. Government Press, Madras.
8. **Vasantharaj David, B. 2003.** Elements of Economic Entomology. Popular Book Depot, Coimbatore.
9. **Vasantharaj David, B and Aanathakrishnan, T.N. 2006.** General and Applied Entomology. Tata McGraw-Hill Publishing House, New Delhi.
10. **Upadhyaya K.P. and Kusum Dwivedi. 1996.** A Text Book of Plant Nematology. Aman Publishing House, Meerut

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# Semester V

**S0548001 Agricultural Marketing and Trade 3(2+1)**

**Objectives:**

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

**Theory:**

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 agricommodities: nature and determinants of demand and supply of farm products, producer's surplus- meaning and its types, marketable and marketed surplus, factors affecting marketable surplusof agri-commodities;

Marketing process and functions: Marketing process concentration, dispersion and equalization; exchange functions – buying and selling; physical functions – storage, transport and processing; facilitating functions – packaging, branding, grading, quality control and labelling (Agmark); Market functionaries and marketing channels: Types and importance of agencies involved in agricultural marketing; meaning and definition of marketing channel; 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 affectingcost of marketing; reasons for higher marketing costs of farm commodities; ways of reducing marketing costs; 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; 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 internationaltrade in agri-commodities; WTO; Agreement on Agriculture (AoA) and its implications on Indian agriculture; IPR; Role of government in agricultural marketing; Role of APMC and its relevance in the present-day context. 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;

**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.

**Suggested readings:**


1 Acharya, S.S. and Agarwal, N.L. 2006. Agricultural Marketing in India, Oxford and IBHPublishing Co. Pvt. Ltd., New Delhi.
2 Chinna, S.S. 2005. Agricultural Economics and Indian Agriculture. Kalyani Pub, N Delhi.
3 Dominic Salvatore, Micro Economic Theory
4 Kohls Richard, L. and Uhl Josheph, N. 2002. Marketing of Agricultural Products, Prentice-Hallof India Private Ltd., New Delhi.
5 Kotler and Armstrong, 2005. Principles of Marketing, Pearson Prentice-Hall.
6 Lekhi, R. K. and Joginder Singh. 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, InternationalBook Distributing Co. Ltd, New Delhi.
9 Sharma, R. 2005. Export Management, Laxmi Narain Agarwal, Agra.


**S0548002 Introduction to Agro-meteorology 2(1+1)**

**Objectives:**

To introduce the students to the concept of weather and climate and underlying physical processes occurring in relation to plant and atmosphere

To impart the theoretical and practical knowledge of instruments/equipment used for measurement of different weather variables in an agrometeorological observatory

To study the meteorological aspects of climate change in agriculture and allied activities

**Theory:**

Meaning and scope of agricultural meteorology; Earth atmosphere: its composition, extent and structure; Atmospheric weather variables; Atmospheric pressure, its variation with height; Wind, types of wind, daily and seasonal variation of wind speed, cyclone, anticyclone, land breeze and sea breeze; Nature and properties of solar radiation, solar constant, depletion of solar radiation, short wave, long wave and thermal radiation, net radiation, albedo; Atmospheric temperature, temperature inversion, lapse rate, daily and seasonal variations of temperature, vertical profile of temperature, Application of Thermal time concept and Crop/Pest weather calendar; Energy balance of earth; 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 rainmaking. Monsoon- mechanism and importance in Indian agriculture; Weather hazards - drought, floods, frost, tropical cyclones and extreme weather conditions such as heat-wave and cold-wave; Agriculture and weather relations; Modifications of crop microclimate, climatic normal for crop and livestock production. Weather forecasting-types of weather forecast and their uses. Climate change, climatic variability, global warming, causes of climate change and its impact 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 soiltemperature and

computation of soil heat flux, Determination of vapor pressure and relative humidity, Determination of dew point temperature, Measurement of atmospheric pressure and analysis of atmospheric conditions, Measurement of wind speed and wind direction, preparationof windrose, 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.

**Suggested Readings:**


1 Agricultural Meteorology by G.S.L.H.V. Prasado Rao
2 Fundamentals of Agrometeorology and Climate Change by G. S. Mahi and P. K. Kingra
3 Introduction to Agrometeorology and Climate Change by Alok Kumar Patra
4 Introduction to Agrometeorology by H. S. Mavi
5 Text Book of Agricultural Meteorology by M. C.Varshneya and P.B. Pillai


**S0548003 Fundamentals of Crop Physiology 3(2+1)**

**Objectives:**

To explain about the basic physiological process of plant viz. plant cell and water relations, mineral nutrition, carbon metabolism, reproductive physiology and plant growth and development

**Theory:**

Definitions of plant physiology and crop physiology; Importance of crop physiology; Relationship of crop physiology with other branches of crop science; Diffusion and osmosis; Physiological roles of water to crop plants; Definition of water potential and components of water potential; Water absorption by plants: Concept of active and passive absorption; Water loss by plants: Types of water loss: transpiration, stomatal physiology and guttation; Water use efficiency;Essential and beneficial elements; Passive and active transport of mineral element; Functionsof essential elements; Criteria of essentiality of nutrients; Correction measures for nutrient deficiency symptoms; Foliar nutrition and root feeding – significance; Aeroponics Imbibition; Field capacity, permanent wilting point and available soil moisture; Apoplast, symplast and transmembrane, Ascent of sap – theories and mechanism; Soil-plant-atmospheric continuum. Significance of transpiration. Stomatal opening and closing mechanisms. Definition of Cavitation and embolism. Antitranspirants - types and examples. Hydroponics and sand culture. Overviewof plant cell - organelle and their functions. Brief outline of: Photosynthetic apparatus, pigment system, quantum requirement and quantum yield; Structure of chloroplast, Examples of different photosynthetic pigments (chlorophyll, carotenoids, phycobilins etc.), Difference between chlorophyll a and chlorophyll b, Structure of chlorophyll a and chlorophyll b, Short discussion on quantum requirement and quantum yield, Red drop and Emerson enhancement effect, Pigment system I and II.

Introduction to light reaction of photosynthesis, Light absorption by photosynthetic pigments and transfer of energy. Source of $O_2$ during photosynthesis: Hill reaction; Brief introduction to cyclic and non-cyclic photo-phosphorylation: production of assimilatory powers; Introduction to $C_3$, $C_4$ and CAM pathways: Calvin Cycle, Hatch and Slack Cycle,CAM Cycle; Significance of these pathways (concept of photorespiration, absence of photorespiration in $C_4$ plant: Productivity of $C_4$ plant, CAM: an adaptive mechanism); Factors affecting photosynthesis (light, temperature, $CO_2$, $O_2$ etc.). Outline of the process of respiration: Definition and importance, Glycolysis, Kreb Cycle and ETC, Factors affecting respiration ($O_2$, temperature, $CO_2$ etc.). Terminologies / Definitions: Growth, Development and Differentiation. Measurement of plant growth (fresh weight, dry weight, linear dimension, area etc.). Introduction to CGR, RGR, NAR etc. Photoperiodism: Photoperiodic Classification of plants: Short Day Plant, Long Day Plant, Day Neutral plantetc. Introduction to Photoperiodic induction site of photo-inductive perception, Role of Phytochrome Introduction to Vernalization (What is vernalization, devernalization etc.), Meaning, classification (seasonal, sequential etc), relation with abscission. Physiological and biochemical changes during senescence, Abscission and its significance, Concept of stay green, Hormonal regulation of senescence. Terminologies / Definitions: Plant hormone,Plant growth regulators (PGR), Plant growth inhibitor. Recognized classes of PGR (Auxins,

Gibberellins, Cytokinins, Ethylene and Abscisic acid) and their major physiological roles, Agricultural uses of PGRs (IBA, NAA, 2, 4 –D, GAs, Kinetin etc).

**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 $C_3$ and $C_4$ plants.

**Suggested readings:**


1 Devlin's Exercises in Plant Physiology by Robert Devlin, Francis H. Witham and David F.Blaydes
2 Fundamentals of Plant Physiology by Lincoln Taiz, Eduardo Zeiger, Ian Max Mølle and AngusMurphy
3 Plant Physiology by Robert M. Devlin and Francis H. Witham
4 Plant Physiology by Lincoln Taiz and Eduardo Zeiger
5 Plant physiology by Frank B. Salisbury and Cleon W. Ross


**S0548004 Pest management in crops and stored grains 3(2+1)**

**Objectives:**

Diagnosis and management of major insect and non- insect pests of crops in field and storage

**Theory:**

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, vegetable crops, fruit crops, plantation crops, ornamental crops, spices and condiments. Structural entomology and important household pests, their nature of damage and management. 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 mites, snails and slugs, 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,

**Practical:**

Field visit, identification of major insect pests and their damage symptoms. Collectionand 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.

**Suggested readings:**


1 A Textbook of Insect Pest and Disease Management, 2021. Somnath Sen, and Mohd. Sameer, S. Kataria & Sons publish.
2 Agricultural Pests of India and South east Asia, A.S. Athwal, Kalyani Publishers.
3 A Textbook of Applied Entomology, K.P. Srivastava and G. S. Dhaliwal, Kalyani Publish.
4 Essentials of Pest Management: Key Information on Pest Identification and its Management,2022. Prakash Rambhat Thalya and Ravi Chandra
5 Integrated pest Management Concept and Approaches- G.S. Dhaliwal and Ramesh Arora
6 Pest Management: Methods, Applications and Challenges, Tarique Hassan Askary, Agriculture, Agriculture Issues and policies, Books, Nova, Pest Control, Science and Technology,2022

**S0548005 Diseases of Field and Horticultural Crops and their Management 3 (2+1)**

**Objectives:**

1. To study the symptoms produced on the host
2. To study the etiology of the diseases
3. To know about the disease cycle of the pathogens during pathogenesis
4. To study the epidemiological factors responsible for disease development
5. To study the management techniques for curbing the major diseases of field and horticulturalcrops

**Theory:**

Symptoms, etiology, disease cycle, epidemiology and management of major diseases of the following field and horticultural crops: Field crops- Rice (blast, brown spot, sheath blight, false smut, bacterial leaf blight, bacterial leaf streak, tungro, khaira); Wheat (rusts, loose smut, Karnal bunt); Maize (banded leaf and sheath blight, southern and northern blight, downy mildew); Sorghum (smuts, grain mold, anthracnose); Bajra (downy mildew, ergot) and Finger millet (blast, leaf spot); Groundnut (early and late leaf spots, rust, wilt); Soybean (rhizoctonia blight, bacterial spot, seed and seedling rot, mosaic); Grams (Ascochyta blight, wilt, grey mold); Pea (downy mildew, powdery mildew, rust); Black gram and Green gram (web blight, Cercosporaleaf spot, anthracnose, yellow mosaic); Sugarcane (red rot, smut, grassy shoot, ratoon stunting, PokahBoeng); Mustard (Alternaria blight, white rust, downy mildew, sclerotinia stem rot) and Sunflower (sclerotinia stem rot, Alternaria blight); Cotton (anthracnose, vascular wilts, black arm). Horticultural crops: Citrus (canker, gummosis) and Guava (wilt, anthracnose); Banana (sigatoka, Panama wilt, bacterial wilt, bunchy top); Papaya (foot rot, leaf curl, mosaic) and Pomegranate (bacterial blight); Apple (scab, powdery mildew, fire blight, crown gall) and Peach (leaf curl); Grapevine (downy mildew, powdery mildew, anthracnose) and Strawberry (leaf spot); Coconut (bud rot, Ganoderma wilt), Tea (blister blight) and Coffee (rust); Mango (anthracnose, malformation, bacterial blight, powdery mildew); Potato (early and late blight, black scurf, leaf roll, mosaic) and Tomato (damping off, wilt, early and late blight, leaf curl, mosaic); Brinjal (phomopsis blight and fruit rot, sclerotinia blight) and Chilli (anthracnose and fruit rot, wilt, leaf curl); Cucurbits (powdery and downy mildew, wilts) and Cruciferous vegetables (Alternaria leaf spot, black rot, cauliflower mosaic); Beans (anthracnose, bacterial blight) and Okra (yellow vein mosaic); Ginger (soft rot), Turmeric (leaf Spot) and Coriander(stem gall); Rose (dieback, powdery mildew, black leaf spot) and Marigold (botrytis blight, leaf spots).

**Practical:**

To study the symptoms of different diseases of field and horticultural crops: Blast and brown spot of rice, sheath blight and bacterial leaf blight of rice, downy mildew and powdery of cucurbits, rhizoctonia and Cercospora leaf spot of green gram / black gram, Alternaria blight and downy mildew of mustard, early blight of late blight of potato and tomato, Phomopsis blight of brinjal, powdery mildew and rust of pea, stem gall of coriander, anthracnose and fruit rot of chilli, taphrina leaf spot of turmeric, red rot of sugarcane, acquaintance with fungicides, antibiotics and biopesticides and their use in management of diseases of horticultural crops. Identification and histopathological studies of selected diseases of field and horticultural crops covered in theory.
Field visit for the diagnosis of field problems, Collection and preservation of plant diseased specimens for herbarium.

**Suggested:**

1. Integrated Plant Disease Management By R.C. Sharma
2. Plant Diseases By R.S. Singh
3. Plant Disease Management: Principles and Practices By Hriday Chaube
4. Plant Pathology By G.N. Agrios

**S0548006 Crop Improvement (*kharif* crops) – I 2(1+1)**

**Objectives:**

1. To provide knowledge about Self-pollinated and cross pollinated *Kharif* crops
2. To learn about origin and distribution of *Kharif* crops
3. To design breeding objectives of major *kharif* crops
4. To impart information on different crop varieties for *Kharif* season

**Theory:**

Centres of origin, distribution of species, wild relatives in different cereals; pulses; oilseeds; fibres; fodders and cash crops; vegetable and other horticultural crops of *kharif* season; 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); Hybrid seed production technology in maize, rice, sorghum, pearl millet and pigeopea etc. Ideotype concept, climate resilient crop varieties for future.

**Practical:**

Botany of crops, Floral biology, emasculation and hybridization techniques in different crop species, viz. rice, jute, maize, sorghum, pearl millet, ragi, pigeopea, urdbean, mungbean, soybean, groundnut, sesame, castor, cotton, cowpea, tabacco, 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.

**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
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


**S0548007 Weed Management 2 (1+1)**

**Objectives:**

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

**Theory**

Introduction to weeds, characteristics of weeds, their harmful and beneficial effects on ecosystem. Classification, reproduction and dissemination of weeds, crop-weed completion, factors of competition, factors affecting growth and development. Studies on weed seed bank, weed shifts. Concepts of weed management: physical, cultural, chemical and biological; principles and methods, integrated weed management. Implements for weed control, roboticweed control, weed management in organic/ natural farming. Herbicide classification and properties of important herbicides, concept of adjuvants, surfactants, herbicide formulation and their use, Nano herbicides, precision weed management; 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. Weed

management in different field and horticultural crops; aquatic weed management, weed management in cropping systems.

**Practical:**

Techniques of weed preservation, weed identification and losses caused by weeds. Biology of important weeds. Study weeds in different situations, 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 problem and parasitic weeds.

**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. KalyaniPublishers, 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.


**S0548008 Ornamental Crops, MAPs and Landscaping 2(1+1)**

**Objectives:**

1. To educate in detail about origin, area, climate, soil, improved varieties production technologyof 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

**Theory:**

Production technology of ashwagandha, costus, isabgol and geranium; Production technology of mint, aloe and ocimum, Coleus, Glory lily, Periwinkle etc.; Production technology of plants like lemongrass, citronella, vetiver and palmarosa etc., Importance and scope of ornamentalcrops; Importance and scope of medicinal and aromatic plants and landscaping; Principles of landscaping; Landscape uses of trees, shrubs and climbers, Production technology of importantcut flowers like rose, gerbera and orchids; Production technology of gladiolus, tuberose andlilium; Production technology of chrysanthemum and carnation; Package of practices for loose flowers like marigold and jasmine under open conditions; Brief concept of Home landscaping, Carpet bedding, Topiary, Bonsai, Lawn, flower arrangement, Herbaceous Border, Hedge, Edge etc.; Processing and value addition imp ornamental crops; 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 plantsby 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.

**Suggested readings:**


1. Floriculture in India by G.S. Randhawa and Mukopadhyay
2. Introduction to spices, plantation crops, medicinal and aromatic plants by N. Kumar, AbdulKhadder, P. Rangaswamy, I. Irulappam
3. Textbook of floriculture and landscaping by Anil K. Singh and Anjana Sisodia
4. Commercial flowers (Vol 1 and 2) by T.K. Bose.


**S0548009 Introductory Agro forestry 2(1+1)**

**Objectives:**

1. To study Agro forestry as an alternate system of land use
2. To study different types of Agro forestry for soil and water conservation.
3. To study the characteristics of Agro forestry in terms its potential for soil moisture conservationpractices

**Theory:**

Agro-forestry: Definition and scope of Agroforestry system, Type of Agroforestry system, potential of Agroforestry in India, Prevailing agroforestry system in India; MPTS- definition, role of MPTS in agroforestry system, its selection for different agroforestry system, MPTS of India, Ecological aspects of Agroforestry system, tree -crop interaction – competition, nutrient recycling; Traditional Agroforestry as a viable choice to conserve Agro biodiversity of India. Management of Agro-forestry system; Role of agroforestry in soil and water conservation; windbreak; Shelterbelt– definition, objectives.; Socio- economic aspects of Agroforestry system; Design and Diagnostic study of agroforetry system; Silviculture: Definition and scope, Propagation of tree species, Regeneration by seed, coppice, root suckers, Transplanting, stump, branch cutting, rhizomes; Nursery bed preparation and management; Cultural practices for bare root and seedling, field handling of nursery stock; Management of tree species; Silviculture of important tree species, choice of species- site factors, root, crown and bole characteristics, phenology, nutritional and water requirement, ground operation, tending, harvesting utility etc. Horticulture and foragecrops-based agroforestry models developed by ICAR-IGFRI; Agroforestry models developed by Indian council of Forestry Research and Education.

**Practical:**

Identification of tree species in agro-forestry, Study of tree growth measurement, Study of environmental parameters affecting AF System, Plant propagation methods, Pre-sowing seed treatment, Preparation of nursery bed exercise, practicing propagation techniques for trees, Afforestation method, practical training, pruning, coppicing, pollarding etc. Planting pattern and designs for plantation, natural and artificial regeneration, Design and diagnostic survey of agro-forestry system, Evaluation of agro-forestry system in different agro climatic zones, Exposure Visit to prevailing agroforestry systems of the state and related important institutions, Virtual visit of agroforestry models developed by ICAR-IGFRI, ICFRE.

**Suggested readings:**


1. Nair, P.K. R. 1993. An Introduction to Agroforestry, Kluar Academic Publisher
2. Chundawat D. S. and S.K. Gautham. 2017. Textbook of Agroforestry. Oxford & IBH Publishing, (ISBN: 9788120408326)
3. Parthiban, K. T, N. Krishnakumar and M. Karthick. 2018. Introduction to Forestry, ScientificPublisher, Jodhpur. 350p
4. Divya M. P. and K. T. Parthiban. 2005. A Textbook on Social Forestry and Agroforestry. SatishSerial Publishing, New Delhi (ISBN: 9384988952)


## Semester VI

**S0648001 Fundamentals of Agricultural Biotechnology 3(2+1)**

**Objectives:**

1. To familiarize the students with the fundamental principles of biotechnology, various developments in biotechnology and its potential applications.

**Theory:**

Introduction to Plant Tissue Culture and Genetic Engineering: History; Cellular tot potency and cytodifferentiation; Callus culture, Single-cell/suspension culture and their applications; Organogenesis and somatic embryogenesis; Somaclonal variation and its use in crop improvement; Embryo rescue technique and its significance in hybrid development; *Invitro* fertilization, ovule culture and its significance in hybrid development; Protoplast isolation, culture and regeneration; Somatic hybridization (somatic hybrids and cybrids) and its application in crop improvement; Anther and pollen culture for haploid production; Development of disease-free (virus free) plants through apical meristem culture; Micropropagation technique for the generation of quality planting material; Synthetic seeds and its applications; National certification and Quality management of TC plants-secondary metabolite production- *in vitro* germplasm conservation.

Introduction to Molecular Biology: DNA structure, structure and function; DNA replication, transcription and translation, RNA, types and function; Structure of prokaryotic and eukaryotic gene; Central dogma of life - DNA replication, transcription, genetic codes-translation and protein synthesis; Lac Operon concept - Nucleic acid hybridization; Polymerase chain reaction- DNA sequencing – Sanger method; PCR and its applications.

Introduction to recombinant DNA technology: DNA modifying enzymes and vectors; plant genetic transformation – physical (Gene gun method), chemical (PEG mediated) and Agrobacterium-mediated gene transfer methods; Transgenic and its importance in crop improvement with successful stories; biosafety. Introduction to various molecular markers: RFLP, RAPD, SSR, SNP etc.; Marker-assisted breeding in crop improvement

**Practical:**

Introduction to Plant Tissue Culture Laboratory; Good Laboratory Practices; Media Preparation and sterilization; Glassware sterilization; Micropropagation; Callus induction and culture; Anther culture; Apical meristem culture; Preparation of synthetic seeds; Isolation of plasmid DNA; Quantification of DNA; Agarose Gel Electrophoresis and visualization of plasmid DNA; Restriction digestion of plasmid DNA and agarose gel electrophoresis; Isolation of Plant genomic DNA; PCR amplification of DNA; Gel electrophoresis of amplified DNA; Visit to tissue culture units/biotech labs.

**Suggested readings:**


1. Bhojwani SS. 1983. Plant Tissue Culture: Theory and Practice. Elsevier.
2. Singh BD. 2007. Biotechnology: Expanding Horiozon. Kalyani
3. Christou P and Klee H. 2004. Handbook of Plant Biotechnology. John Wiley & Sons.
4. Lewin B. 2008. Gene IX. Peterson Publications/ Panima. W.H. Freeman & Co.
5. Primrose SB. 2001. Molecular Biotechnology. Panima.


**S0648002 Course Title: Basic and Applied Agricultural Statistics 3(2+1)**

**Objectives:**

To provide an idea on statistical concepts of both descriptive and inference Statisticswhich will be useful to do statistical analysis

**Theory:**

Introduction to Statistics and its Applications in Agriculture. Types of Data. Scales of measurements of Data. Summarization of Data. Classification of Data. Frequency Distribution. Methods of Classification. Definition of Grouped and Ungrouped Data. Definition of Class Interval (formula for determining the no. of class interval), Width of CI, Class Limits (Boundaries), Mid Points. Types of Frequency Distribution. Diagrammatic Presentation of Data. Bar Diagrams – Simple, Multiple, Sub-divided and Percentage Bar Diagrams. Pie-diagram. Graphical Presentation of Data – Histogram, Frequency Polygon and Ogives.

Measures of Central Tendency. Requisites for an Ideal Measure of Central Tendency. Different Types of Measure. Arithmetic Mean– Definition, Properties, Merits, Demerits and Uses. A.M. (examples) for Grouped and Ungrouped Data. Step-deviation Method. Weighted Mean. Definition of Geometric Mean and Harmonic Mean. Relationship between A.M., G.M. and H.M. Median- Definition, Merits, Demerits and Uses. Graphical Location of Median. Mode- Definition, Merits, Demerits and Uses. Graphical Location of Mode. Relationship between Mean, Median and Mode.

Measures of Dispersion. Characteristics for an Ideal Measure of Dispersion. Different Types of Measures of Dispersions. Definition of Range, Interquartile Range, Quartile Deviation and Mean Deviation. Standard Deviation- Definition, Properties. S.D. and Variance for Grouped and Ungrouped Data. Variance of Combined Series. Co-efficients of Dispersions. Co-efficient of Variation.

Measures of Skewness and Kurtosis. Definition of Symmetrical Distribution. Definition of Skewness, Measures of Skewness. Definition of Kurtosis. Measure of Kurtosis. Relationship between Mean, Median and Mode for Symmetrical and Skewed Distribution.

Probability Theory and Normal Distribution. Introduction to Probability. Basic Terminologies. Classical Probability-Definition and Limitations. Empirical Probability- Definition and Limitations. Axiomatic Probability.

Addition and Multiplication Theorem (without proof). Conditional Probability. Independent Events. Simple Problems based on Probability. Definition of Random Variable. Discrete and Continuous Random Variable. Normal Distribution- Definition, Prob. Distribution, Mean and Variance. Assumptions of Normal Distribution. Normal Probability Curve. Correlation and Regression. Definition of Correlation. Scatter Diagram. Karl Pearson's Coefficient of Correlation. Types of Correlation Coefficient. Properties of Correlation Coefficient. Definition of Linear Regression. Regression Equations. Regression Coefficients. Properties of Regression Coefficients. Tests of Significance. Definition. Null and Alternative Hypothesis. Type I and Type II Error. Critical Region and Level of Significance. One Tailed and Two Tailed Tests. Test Statistic. One Sample, Two Sample and Paired t-test with Examples. F-test for Variance. ANOVA and Experimental Designs. Definition of ANOVA. Assignable and Non assignable Factors. Analysis of One-way Classified Data. Basic Examples of Experimental Designs. Terminologies. Completely Randomized Design (CRD). Sampling Theory. Introduction. Definition of Population, Sample, Parameter and Statistic. Sampling Vs Complete Enumeration. Sampling Methods. Simple Random Sampling with Replacement and without Replacement. Use of Random Number Table.

**Practical:**

Diagrammatic and Graphical representation of data. Calculation of A.M., Median and Mode (Ungrouped and Grouped data). Calculation of S.D. and C.V. (Ungrouped and Grouped data). Correlation and Regression analysis. Application of t-test (one sample, two sample independent and dependent). Analysis of variance one-way classification. CRD. Selection of random sample using simple random sampling.

Suggested readings

Fundamentals of Statistics by D. N. Elhance, Kitab Mahal Publishers.
Fundamentals of Applied Statistics by S.C. Gupta and V. K. Kapoor, Sultan Chand and Sons.
Basic Statistics by B. L. Agarwal, New Age International Publishers.
Agricultural Statistics by S.P. Singh and R.P.S. Verma, Rama Publishing House.
Agriculture and Applied Statistics-I by P.K. Sahu, Kalyani Publishers.
Agriculture and Applied Statistics-II by P. K. Sahu and A. K. Das, Kalyani Publishers.

**S0648003 Crop Improvement (*Rabi* crops)- II 2(1+1)**

**Objectives:**

1. To provide knowledge about self-pollinated and cross-pollinated *rabi* crops
2. To learn about origin and distribution of *rabi* crops
3. To design breeding objectives of major *rabi* crops
4. To impart information on different crop varieties for *rabi* season

**Theory:**

Centres of origin, distribution of species, wild relatives in different cereals; pulses; oilseeds; fibres; fodders and cash crops; vegetable and other horticultural crops; 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); Hybrid seed production technology in wheat, oat, chickpea, rapeseed and mustard etc. Ideotype concept, climate resilient crop varieties for future.

**Practical**

Botany of crops, Floral biology, emasculation and hybridization techniques in different crop species, viz. wheat, oat, rapeseed and mustard, pulses, potato, sugarcane, tomato, chilli, onion etc. Study of field techniques for seed production and hybrid seed production in rabi crops; Estimation of heterosis, inbreeding depression and heritability; Study of quality characters, donor parents for different characters; Visit to seed production plots; Visit to AICRP breeding plots of different crops.

**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
7. Breeding Asian field Crops by J.M. Poehlman and D.N. Barthakur
8. Practical Manuals on Crop Improvement I (*Rabi* crops) by Rajendra Kumar Yadav


**S0648004 Renewable energy in Agriculture and Allied Sector 2(1+1)**

**Objectives:**

1. To gain the knowledge on different types of materials used in Renewable Energy
2. To understand the importance of Renewable Energy technology and its applications
3. To train the students on the applications of solar thermal technology

**Theory:**

Classification of energy sources, contribution of these of sources in agricultural sector; Familiarization with biomass utilization for biofuel production and their application; Familiarization with types of biogas plants and gasifiers, biogas, bioalcohol, biodiesel and biooil production and their utilization as bioenergy resource;

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; Introduction of wind energy and their application. Availability of bio mass and their application indifferent places.

**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.

**Suggested readings:**


1. C.S. Solanki. 2011. Solar Photovoltaic – Fundamentals, Technologies and Applications. PHILearning Pvt. Ltd.
2. S. Sukhatme and J. Nayak. 2008. Solar Energy: Principles of Thermal Collection and Storage.Third Edition (Tata McGraw-Hill).
3. V.V.N. Kishore. 2008. Renewable Energy Engineering and Technology: Principles and Practice,Teri, India.


**S0648005 Dryland agriculture/ Rainfed agriculture and watershed management 2(1+1)**

**Objectives:**

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

**Theory:**

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 Soil Moisture Availability (SMA) and its impact on crop and cropping system; Soil and water conservation techniques; 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; Crops and cropping systems in dry land/rainfed areas; Management of crops in dry land/rainfed areas; Contingent crop planning for aberrant weather conditions; Concept, history, objective, principles and components of watershed management, factors affecting watershed management. Log term rainfall analysis in relation to simple mathematical models and forecasting the weather abnormalities; Alternate land use system location; regional andcrop 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 countryand 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.

**Suggested readings:**


1. A.K. Srivastava and P.K. Tyagi. 2011. Practical Agricultural Meteorology. New Delhi PublishingAgency, New Delhi.
2. 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., NewDelhi.
4. H.S. Mavi and Graeme J. Tupper. 2005. Agrometeorology – Principles and applications ofclimate 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.


**S0648006 Agricultural Microbiology and Phyto-remediation 2(1+1)**

**Objectives:**

1. To get an introduction to microbiology with specific focus on its significance in agriculture science
2. To get acquainted with the bacterial structure and the function of the different bacterial components
3. To get highlights on different fields of microbiology
4. To get highlights on the bioremediation of polluted soils using microbial mediators and phyto-remediation
5. To get a concept of biological control and the role of biopesticides in plant disease management.

**Theory:**

Introduction to Microbiology: 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. Bacteria: cell structure, chemoautotrophy, photo autotrophy, growth. Bacterial genetics: Genetic recombination-transformation, conjugation and transduction, genetic engineering. Soil Microbiology: Nutrient mineralization and transformation, Air Microbiology: Phyllosphere microflora, Phylloplane microflora, microflora of floral parts etc. Food Microbiology: Microbial spoilage and principles of food preservations, Food poisoning. Water Microbiology: Types of water, water microorganisms, and microbial analysis of water e.g. coliform test, Purification of water. Industrial Microbiology: Microbial products, Biodegradation, Biogas production, Biodegradable plastics etc. Biological control: Microbial biopesticides for plant disease management 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.

**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 nigrosin; 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.

**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 IndiaPvt. 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


**S0648007 Agricultural Finance and Cooperation 2(1+1)**

**Objectives:**

1. To impart knowledge on issues related to lending to priority sector credit management and financial risk management

**Theory:**

Agricultural Finance- meaning, scope and significance, credit needs and its role in Indian agriculture. Agricultural credit: meaning, definition, need, classification. Credit analysis:. 3 R's, 5 C's and 7 P's of credit Sources of agricultural finance: institutional and non- institutional sources, commercial banks, social control and nationalization of commercial banks. Micro financing including KCC. 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. Preparation and analysis of financial statements – Balance Sheet and Income Statement. Basic guidelines for preparation of project reports. Bank norms – SWOT analysis. Agricultural Cooperation – Meaning, brief history of cooperative development in India, objectives, principles of cooperation, significance of cooperatives in Indian agriculture. Agricultural Cooperation in India- credit, marketing, consumer and multi-purpose cooperatives, farmers' service cooperative societies, processing cooperatives, farming cooperatives, cooperative warehousing; role of ICA, NCUI, NCDC, NAFED.. Crop insurance: its scope, significance and limitations and the potential of the newly launched 'Pradhan Mantri Fasal Bima Yojana' (Prime Minister's Crop Insurance Scheme). Successful cooperative systems in Gujarat (AMUL), Tamil Nadu (Aavin), Karnataka (Nandini), Maharashtra and Punjab.

**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.

**Suggested readings**


1. Gittinger, J.P. 1982. Economic Analysis of Agricultural Projects. The Johns Hopkins Univ.Press.
2. Reddy, S. S. and Ram, P.R. 1996. Agricultural Finance and Management. Oxford & IBH.


**S0648008 Essentials of Plant Biochemistry 3 (2+1)**

**Objective:**

1. To impart the fundamental knowledge on structure and function of cellular components, biomolecules and the biological processes in plants

**Theory:**

Biochemistry – Introduction and importance, Properties of water, pH and buffer, plant cell andits components. Bio-molecules – Structure, classification, properties and function of carbohydrates, amino acids, proteins, lipids and nucleic acids. Vitamins – physiological and metabolic role. Enzymes: General properties; Classification; Mechanism of action; Michaelis and Menten and Line Weaver Burk equation and plots; Introduction to allosteric enzymes, use of enzymes. Metabolic energy and its generation – Metabolism – Basic concepts, Glycolysis, Citric acid Cycle, Pentose phosphate pathway, oxidative phosphorylation, Fatty acid oxidation. Biosynthetic Pathways – Photosynthesis, Gluconeogenesis, nitrogen fixation, fatty acid and starch formation. Regulation of metabolic pathways. Secondary metabolites, Terpenoids, Alkaloids, Phenolic and their applications in food and pharmaceutical industries.

**Practical:**

Preparation of standard solutions and reagents, Determination of pH, 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 valueand iodine number, Estimation of ascorbic acid, Qualitative/quantitative tests of secondary metabolites.

**Suggested Readings:**


1. Nelson and Cox. 2008. Lehninger Principles of Biochemistry. Fourth/Fifth edition. Freeman(Can be downloaded)
2. Conn, Stumpf, Bruening and Doi. 2006. Outlines of Biochemistry. Fifth Edition. Wiley
3. Horton, Moran, Rawn, Scrimgeour, Perry. 2011. Principles of Biochemistry. Fifth Edition. Pearson/Prentice Hall (Can be downloaded)
4. Heldt. 2005. Plant Biochemistry. Elsevier (Can be downloaded)
5. Goodwin and Mercer. 2005. Introduction to Plant Biochemistry. 2nd edition. CBS.


**S0648009 Fundamentals of Seed Science and Technology 2 (1 + 1)**

**Objectives:**

1. To impart basic and fundamental knowledge on principles and practices seed science andtechnology
2. To impart practical skills on scientific seed production and post-harvest quality management

**Theory:**

Introduction to seed technology, definition and importance; Seed quality -definition, charactersof good quality seed; Causes of deterioration of varietal purity and assessment of genetic purity, different classes of seed. Foundation and certified seed production of important cereals, pulses and

oilseed, field inspection, importance and procedures; Post-harvest seed quality management; seed processing procedures, seed drying; Seed treatment, its importance, method of application and seed packing; seed storage - general principles, stages and factors affecting seed longevity during storage; Seed health management during storage. Seed Certification and legislation; Seed Act and 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; Seed quality enhancement techniques.

**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.

**Suggested Readings:**


1. Agarwal, R.L. 1995. Seed Technology (2nd edition). Oxford & IBH Publishing Co. Pvt. Ltd. NewDelhi, India.
2. Khare, D. and Bhale, M.S. 2019. Seed Technology (2nd revised & enlarged edn), ScientificPublishers, 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 Publ
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.


**S0648010 Insect Ecology and Integrated Pest Management 3 (2+1)**

**Course Objective:** To provide students with a comprehensive understanding of insect ecology, pest management principles, and the application of IPM strategies.

**Theory**
Insect Ecology: Introduction, Environment and its components. Effect of Abiotic factors– temperature, moisture, humidity, rainfall, light, atmospheric pressure and air currents. Effect of Biotic factors – food competition, natural and environmental resistance. Concepts of Balance of life in nature, biotic potential and environmental resistance and causes for outbreak of pests in agro-ecosystem. Pest surveillance and pest forecasting and Categories of pests. Host plant resistance. Categories of insect pests, IPM: Introduction, history, importance, concepts, principles and tools of IPM. Economic importance of insect- pests and pest risk analysis. Methods of detection and diagnosis of insect-pests. Calculation and dynamics of economic injury level and importance of Economic threshold level. Methods of control: Host plant resistance, cultural, mechanical, physical, legislative, biological and chemical control. Ecological management of crop environment. Introduction to conventional pesticides for the insect -pests management. Survey-surveillance and forecasting of Insect-pests. Development and validation of IPM module. Implementation and impact of IPM (IPM module for Insect -pests). Safety issues in pesticide uses. Political, social and legal implication of IPM. Case histories of important IPM programmes.

**Practicals:**
Methods of diagnosis and detection of various insect -pests, , Methods of insect -pests and measurement, Assessment of crop yield losses, calculations based on economics of IPM, Identification of biocontrol agents, different predators and natural enemies. Mass multiplication of Trichoderma, Pseudomonas, Trichogramma, NPV etc. Identification and nature of damage of important insect -pests and their management. Crop (agro-ecosystem) dynamics of a selected insect

-pest. Plan & assess preventive strategies (IPM module) and decision making. crop monitoring attacked by insect- pests. Awareness campaign at farmer's fields.

**Suggested Readings:**


1. Integrated Pest Management-Concepts and Approaches: Dhwaliwal GS and Ramesh Arora (2001), Kalyanai Publishers, Ludhiana.
2. Biological Pest Suppression; Gautam RD (2008), Westville Publishing House, New Delhi.
3. Introduction to Insect Pest Management; Metcalf RL and Luckman WH (1982), Wiley Inter Science Publishing, New York.
4. General and Applied Entomology; Nair KK, Ananthakrishnan, TN and David BV (1976), Tata McGeaw Hill Publishing Company Ltd, New Delhi.
5. Entomology and Pest Management; Larry E Pedigo and Marlin E Rice (1991), Prentice Hall of India Private Ltd, New Delhi.
6. Principles of Insect Pathology; Steinhaus EA (1949), McGraw Hill Book Co., New York.
7. Integrated Insect Pest Management; Venugopala Rao N, Umamaheswari T, Rajendraprasad P, Naidu VG and Savitri P (2004), Agrobios (India) Limited, Jodhpur.
8. Elements of Insect Ecology; Yazdani SS and Agarwal ML (1979), Narosa Publishing House, New Delhi.
9. A Text Book of Applied Entomology (Vol I & II); Srivatsava KP (1996), Kalyani Publishers, Ludhiana.
10. Botanical and Biopesticides; Parmar BS and Devakumar C (1994), Westvill Publishing House, New Delhi.
11. Plant Protection Techniques; Chaterjee PB (1997), Bharati Bhavan, New Delhi.
12. Insecticides: Toxicology & Uses; Gupta HCL (1998), Agrotech Publishing Academy, Udaipur.
13. Alternatives to Chemical Pesticides in Pest Management; Gupta HCL (2008), Agrotech Books, Udaipur.
14. Integrated Pest Management and Biocontrol; Dwivedi SC, Dwivedi Nalini (2006), Estern Book Corporation, Kolkata
15. Ecologically Based Integrated Pest Management; Opender Koul and Gerrit W Cuperus (2007), CABI Publishing.
16. Insect Ecology; Peter W Price (1997), Wiley.
17. Insect Ecology; Prakash M (2008), Discovery Publishing House Pvt Ltd.
18. Ecology; Odum (1975), Oxford & IBH Publishing Co.
19. Fundamentals of Ecology; Odum Eugene (1996), Natrraj Publishers.


**S0648011 Educational Tour (0+2)**

Visit of Research Institution, KVK, Agricultural University, Agricultural Farm, Training Institute and Center Agricultural Industry and advance Agricultural Sector. Prepare the Study Reports Every Students.

## Semester VII

| S. No | Course title | Total credits |
|---|---|---|
| 1 | 5 Elective Courses each of 4 (3+1) credits/Research Project with related courses | 20 |
| | Total | 20 |

## ELECTIVE COURSES

### Fourth year VII Semester

| List of Elective Courses (Choose any five) | | | |
|---|---|---|---|
| **Course No.** | **Name of Course** | **Credit** | **Total credit** |
| S0748001 | Agri-Business Management | 4(3+1) | 20 (15+5) |
| S0748002 | Management of Natural resources | 4(3+1) | |
| S0748003 | Agrochemicals | 4(3+1) | |
| S0748004 | Landscaping | 4(3+1) | |
| S0748005 | Commercial Plant breeding | 4(3+1) | |
| S0748006 | Food Safety and standards | 4(3+1) | |
| S0748007 | System Simulation and Agro advisory | 4(3+1) | |
| S0748008 | Hi-tech Horticulture | 4(3+1) | |
| S0748009 | Protected cultivation | 4(3+1) | |
| S0748010 | Micro-propagation Technologies | 4(3+1) | |
| S0748011 | Commercial Seed Production | 4(3+1) | |
| S0748012 | Principles and Practices of organic farming/conservation agriculture | 4(3+1) | |
| S0748013 | Post-Harvest Technology and value addition | 4(3+1) | |
| S0748014 | Agricultural Journalism | 4(3+1) | |
| S0748015 | Climate resilient Agriculture | 4(3+1) | |

More electives to be included by the universities / institutions, based on the facilities/ expertiseavailable such as nano fertilizers, robotics, use of drones in agriculture etc

## Elective course 1

**S0748001 Agri-Business Management 4 (3+1)**

**Objectives:**
To impart knowledge on understanding the concepts processes, significance, and role of management and organizational behaviour.

**Theory :**
Transformation of agriculture into agribusiness, various stakeholders and components of agribusiness systems. Importance of agribusiness in the Indian economy and New Agricultural Policy. Distinctive features of Agribusiness Management: Importance and needs of agro-based industries. Classification of industries and types of agro based industries. Institutional arrangement, procedures to set up agro based industries. Constraints in establishing agro-based industries. Agri-value chain: Understanding primary and support activities and their linkages. Business environment: PEST and SWOT analysis. Management functions: Roles and activities, Organization culture. Planning, meaning, definition, types of plans. Purpose or mission, goals or objectives, Strategies, polices procedures, rules, programs and budget. Components of a business plan, Steps in planning and implementation. Organization staffing, directing and motivation. 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 behaviour analysis, Product Life Cycle (PLC). Sales and Distribution Management. Pricing policy, various pricing methods. Project

Management definition, project cycle, identification, formulation, appraisal, implementation, monitoring and evaluation. Project Appraisal and evaluation techniques.

**Practical:**

Study of agri –input markets: Seed, fertilizers pesticides. Study of output markets: grains, fruits, vegetables, flowers. Study of product market, retails 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 entrepreneur. Appraisal /evaluation techniques of identifying viable project- Non discounting techniques. Case study of agro- based industries. Trend and growth rate of price of agricultural commodities. Net present worth technique for selection of viable project. Internal rate of return.

**Suggested readings:**


1. Broadway, A.C. and Broadway, Arif, A. 2002. A textbook of Agri-Business Management.Kalyani Publishers
2. Bairwa, S.L. 2016. Objective on Fundamentals of Agri-business Management. Kalyani Publishers
3. Anjan Nishra, Debasish Biswas and Arunangshu Giri. 2019. Agribusiness Management, Himalaya Publishing House, 220p.
4. Shoji Lal Bairwa, Chandra Sen, L.K. Meena and Meera Kumari. 2018. Agribusiness ManagementTheory and Practices, Write and Print Publications.
5. Virender Kamalvanshi. Agribusiness Management. Random.


## Elective Course-2

**S0748002 Management of natural resources 4 (3+1)**

**Objectives:**

1. To enlighten students about available natural resources and their relationship with cropproduction
2. To impart the knowledge of principles and practices of natural resource management.

**Theory:**

Introduction to Natural Resource Bases: Concept of resource, classification of natural resources. Factors influencing resource availability, distribution and uses. Interrelationships amongdifferent 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, 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. Energy resources: Growing energy needs, renewable and non-renewable 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. 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, Water harvesting techniques - Lining of ponds, tanks and canal systems.

**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 tonearby farm pond. Visit to an erosion site. Exposure to strip cropping/contour bunding.

**Suggested readings:**


1. Sustainable Natural Resource Management by Danill R. Lynch.
2. Management of Natural Resource for Sustainable Development, by Vijay Singh Rathor and BS 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 Blackswan284p.
5. Natural Resources: Their Conservation and Management by Arvindrai Upadhyay. AspirationAcademy, 320p.
6. Natural Resource Management for Growth Development and Sustainability by VasudevaSrishti Pal.Today & Tomorrows Printers and Publishers, 336p.
7.


## Elective course 3

**S0748003 Agrochemicals 4 (3+1)**

**Objectives:**

To impart knowledge on different classes of agrochemicals

**Theory:**

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. 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 and insecticides: inorganic and organic insecticides organochorine, Ogranophosphates, Carbamates, Synthetic pyrethriods Neonicotinoids, Biorationals. 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. Fertilizers and their importance. Nitrogenous fertilizers: Feedstocks and Manufacturing of ammonium sulphate, ammonium nitrate, ammonium chloride, urea. Slow release N-fertilizers. Phosphatic fertilizers: feedstock and manufacturing of single superphosphate. Preparation of bone meal and basic slag. Potassic fertilizers: Natural sources of potash, manufacturing of potassium chloride, potassium sulphate and potassium nitrate. Mixed and complex fertilizers: Sources and compatibility-preparation of major, secondary and micronutrient mixtures. Complex fertilizers: Manufacturing of

ammonium phosphates, nitrophosphates and NPK complexes. Fertilizer control order. Fertilizer logistic and marketing. Plant bio-pesticides for ecological agriculture, Bio-insect repellent.

**Practical:**

Sampling of fertilizers and pesticides. Pesticides application technology to study about various pesticides appliances. Quick tests for identification of common fertilizers. Identification of anion and cation in fertilizer. Calculation of doses of insecticides to be used. To study and identify various formulations of insecticide available kin market. Estimation of nitrogen in Urea. Estimation of water soluble P2 O5 and citrate soluble P2 O5 in single super phosphate. Estimation of potassium in Muraite of Potash/ Sulphate of Potash by flame photometer. Determination of copper content in copper oxychloride. Determination of sulphur content in sulphur fungicide.

**Suggested Reading**


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 & EquipmentDetails. 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.


## Elective course 4

S0748004 **Landscaping** **4 (3+1)**

**Objectives:**

1. To educate the students on designing different styles and types of gardens
2. To enable the students to identify different ornamental plants and their utilization in landscapingdesign
3. To enable students to design landscapes in softwares like AUTOCAD, ARCHCADE etc.

**Theory:**

Importance and scope of landscaping. Principles of landscaping, garden styles and types terrace gardening, vertical gardening, garden components, adornments, lawn making, rockery watergarden, walk-paths, bridges, other constructed features etc. Gardens for special purposes. Trees: selection, propagation, planting schemes, canopy management. Shrubs and herbaceous perennials:selection, propagation, planting schemes, architecture. Climber and creepers importance, selection, propagation, planting. Annuals: selection, propagation, planting scheme. Other garden plants: palms, ferns, grasses and cacti succulents. Pot plants: selection, arrangement, management. Bio-aesthetic planning: definition, need, planning. Landscaping of urban and rural areas, Peri-urban landscaping, Landscaping of schools, public places like bus station, railway station, townships, river banks, hospitals, play grounds, airports, industries, institutions, Bonsai principles and management. Lawn: establishment and maintenance. CAD application.

**Practical:**

Identification of trees, shrubs, annuals, pot plants; Propagation of trees, shrubs and annuals; Care and maintenance of plants, potting and repotting; Identification of tools and implements usedin landscape design. Training and pruning of plants for special effects. Lawn establishment and maintenance. Layout of formal gardens, informal gardens, special type of gardens (sunken garden, terrace garden, rock garden) and designing of conservatory and lathe house. Use of computer software. Visit to important gardens /parks /institutes.

**Suggested Reading**


1. Textbook of floriculture and landscaping by Anil K. Singh and Anjana Sisodia
2. Principles of Landscape Gardening: Y. Chandrasekhar and Hemla Naik B. 2020. ICAR.
3. Introductory Ornamental Horticulture and Landscape Gardening: Rajaneesh Singh and Brijendra Kumar Singh. 2020, Bio-Green Books.
4. Principles of Landscape Architecture: Pragnyashree Mishra and Bhimasen Naik. 2022. NewIndia Publishing Agency.

5. Landscape Gardening: Sudhir Pradhan. 2018. Scientific Publishers India.

## Elective course 5

S0748005 **Commercial Plant breeding** **4 (3+1)**

**Objectives:**

1. To discuss about hybrid development and various crop improvement aspects of field crops viz.,rice, wheat, maize, pearl millet, sorghum, pigeonpea, chickpea, green gram, black gram, lentil,soybean, groundnut, rapeseed-mustard, cotton etc.
2. To provide understanding on tissue culture and biotechnological approaches as alternative strategies for development of line and cultivars
3. To impart knowledge on seed production, release and notification of varieties and PPV&FR Act, 2001

**Theory:**

Types of crops and modes of plant reproduction. Line development and maintenance breedingin self- and cross- pollinated crops (A/B/R and two-line system)

for development of hybrids and seedproduction. Genetic test of commercial hybrids. Advances in hybrid seed production of maize, rice,sorghum, pearl millet, castor, sunflower, cotton pigeon pea, Brassica etc. Speed Breeding, BreedingManagement systems, High-throughput phenotyping and genotyping platforms, Quality seed production of vegetable crops under open and protected environment. Alternative strategies for thedevelopment of the line cultivators: haploid inducer, tissue culture techniques and biotechnologicaltools. IPR issues in commercial plant breeding: DUS testing and registration of verities under PPVand FR Act. Variety testing, release and notification systems in India. Principles and techniques ofseed production, types of seeds, quality testing in self- and cross- pollinated crops.

**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.

**Suggested readings:**


1. Commercial Plant Breeding at a glance by Phundan Singh, Pratibha Bisen, Reshu Tiwari. DayaPublishing 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.Astral Publishing, 160p.
6. Breeding and Crop Production: H. Padmalatha, Random.
7. Biotechnology for Agricultural Breeding: Mangal, S. K. GeneTech Books.


## Elective course 6

S0748006 **Food safety and standards** **4 (3+1)**

**Objectives:**

1. To develop the skills to convert raw materials into safe, attractive food products
2. To manage the production of food products
3. To use scientific knowledge to develop new products

**Theory:**

Food safety –Definition, Importance, Scope and Factors affecting Food Safety. Hazards and Risks, Type of Hazards - Biological, Chemical Physical hazards. Management of hazards – Need. Control of Parameters. Temperature Control. Food Storage. Production Design. Hygiene and Sanitation in Food Service Establishments- Introduction. Sources of contamination and their control. Waste Disposal. Pest and Rodent Control. Personnel Hygiene. Food safety Measures. Food Safety Management Tool- Basic concepts. PRPs, GHPs, GMPs, SSOPs etc. HACCP.ISO series. TQM-concept and need for quality, components of TQM, Kaizen. Risk Analysis. Accreditation and Auditing, Water Analysis, Surface Sanitation and Personal Hygine. Food laws and Standards Indian Food Regulatory Regime, FSSA. Global Scenario CAC. Other laws and standards related to food. Recent concerns -New and Emerging Pathogens. Packaging, Product labelling and Nutritional labelling. Genetically modified food/transgenic. Organic foods. Newer approaches to food safety. Recent Outbreaks. Indian and International Standards for food products.

**Practical**

Water quality analysis physico – chemical and microbiological. Preparation of different types of media. Microbiological examination of different food samples. Assessment of surface sanitation by swab/rinse method. Assessment of personal hygiene. Biochemical tests for identification of bacteria. Scheme for the detection of food borne pathogens. Preparation of plants for Implementation of FSMS-HACCP, ISO:22000.

**Suggested Reading:**


1. Text book of Food Science and Technology: Avantina Sharma.
2. Handbook of Food Safety: D.S.L. Khatekar and N. Sarkate. Step Up Academy, 576p.
3. Food and Beverage Management: Bernard Davis. Andrew Lockwood, Ioannis Pantelidis, Peter Alcott Routle.dge
4. Food safety and Quality Control: Pulkit Mathur. The Orient Blackswan.332p.
5. Safe Food Handling: HACCP booklet for Food Handlers. Cletus Fernandes, Notion Press.


## Elective Course-7

S0748007 **System Simulation and Agro-advisory** **4 (3+1)**

**Objectives:**

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

**Theory:**

System approach for representing soil-plant-atmospheric continuum, system boundaries. Crop models, concepts and techniques, types of crop models, data requirements, relational diagrams. Evaluation of crop responses to weather elements; Elementary crop growth models; calibration, validation, verification and sensitivity analysis. 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. Weather forecasting, types methods, tools and techniques, forecast verification; Value added weather forecast, ITK for weather forecast and its validity; Crop- Weather Calendars; Preparation of agro-advisory bulletin based on weather forecast. Use of crop simulation model for preparation of Agro- advisory and its effective dissemination.

**Practical**

Preparation of crop weather calendars. Preparation of agro-advisories based on weather forecast using various approaches and synoptic charts. Working with statistical and simulation models for crop growth. Potential 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.

**Suggested readings:**


1. Introduction to Agrometeorology by H. S. Mavi.
2. Agricultural Meteorology by G.S.L.H.V. Prasado Rao.
3. 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.
4. Text Book of Agricultural Meteorology by M.C. Varshneya and P.B. Pillai. ICAR.
5. Principles of Agricultural Meteorology by OP Bishnoi.


**Elective course 08**

S0748008 **Hi-tech Horticulture** **4 (3+1)**

**Objectives:**

1. To educate the students on the latest technology of hi-tech horticulture
2. To educate students on the concepts and prospects of hi-tech horticulture

**Theory**

Introduction and importance; Nursery management and mechanization; micro propagationof horticultural crops; Modern field preparation and planting methods; Protected cultivation: advantages, controlled conditions, method and techniques; Micro irrigation systems and its components; EC, pH based fertilizer scheduling; canopy management; high density orcharding; Components of precision farming: Remote sensing; Geographical Information System (GIS); Differential Geo-positioning System (DGPS); Variable Rate Applicator (VRA); application of precision farming in horticultural crops (fruits, vegetables and ornamental crops); mechanized harvesting of produce.

**Practical:**

Types of polyhouses and shade net houses, Intercultural operations, tools and equipment identification and application, Micro propagation, Nursery- portrays, micro-irrigation, EC, pH based fertilizer scheduling, canopy management, visit to hi-tech orchard/nursery.

**Suggested readings:**


1. Hi-tech Horticulture by T.A. More.
2. Greenhouse Operation and Management by Paul V. Nelson.
3. Hi Tech Horticulture (Pb) by S. Prasad, Dharam Singh and R.L. Bharadwaj. Agrobios
4. Instant Horticulture by S.N. Gupta. Jain Brothers. 488p.
5. Hydroponics for Beginners and Advanced: The Ultimate Hydroponic and Aquaponic Gardening Guide by Tom Garden, Webb Eleanor.


**Elective course 09**

S0748009 **Protected cultivation** **4(3+1)**

**Objective:**

To educate students on the scientific and commercial cultivation of important value-added products in protected cultivation

**Theory:**

Protected cultivation- importance and scope, status of protected cultivation in India and World,types of protected structure based on site and climate. Cladding material involved in greenhouse/ poly house. Greenhouse design, environment control, artificial lights, Automation. Soil preparationand management, Substrate management. Types of benches and containers, Irrigation and fertigation management. Propagation and production of quality planting material of horticultural crops. Greenhouse cultivation of important horticultural crops-rose, carnation, chrysanthemum, gerbera, orchid, anthurium, lilium, tulip, tomato, bell pepper, cucumber, strawberry, pot plants etc. Cultivation of economically important medicinal and aromatic plants. Off- season production of flowers and vegetables. Insect pest and disease management.

**Practical:**

Raising of seedlings and saplings under protected conditions, Use of portrays in quality planting material production, Bed preparation and planting of crop for production. Inter cultural operations, Soil EC and pH measurement. Regulation of irrigation and fertilizers through drip, fogging and misting.

**Suggested readings:**


1. Greenhouse operation and management by Paul V. Nelson.
2. Protected cultivation of Horticultural crops by Madan Kr. Jha, Sujan Singh Paikra and ManjuRani Sahu.
3. Protected Cultivation of Horticulture Crops by Itigi Prabhakar. IBPSS.
4. Advances in Protected Cultivation by Brahma Singh and Balraj Singh. NIPA,252p.
5. Protected Cultivation and Smart Agriculture by Eds. Sagar Maitra, Dinkar J. Gaikwad andTanmoy Shankar. New Delhi Publishers, 263p.
6. Textbook of Protected Cultivation and Precision Farming for Horticultural Crops by B. AshokKumar, Eggadi Ramesh and Sindhu V. Jain Brothers.


## Elective Course-10

S0748010 **Micro-propagation Technologies** **4 (3+1)**

**Objectives:**

To educate the students in detail about the sterilization techniques for explants, preparationof stocks and working solution, culturing of explants, regeneration of whole plants from different explants and hardening procedures.

**Theory:**

Introduction, History, Advantages and limitations. Types of cultures (seed, embryo, organ, callus, cell); Stages of micro propagation; Axillary bud proliferation (Shoot tip and meristem culture,bud culture); Organogenesis (calluys and direct organ formation); Somatic embryogenesis; Cell suspension cultures; production of secondary metabolites; Somaclonal variation; Cryopreservation.

**Practical:**

Identification and use of equipment in tissue culture Laboratory; Nutrition media composition; Sterilization techniques for media, containers and small instruments; Sterilization techniques for explants; Preparation of stocks and working solution; Preparation of working medium; Culturing of explants: Seeds, shoot tip and single node; Callus induction; Induction of somatic embryos regeneration of whole plants from different explants; Hardening procedures.

**Suggested readings:**


1. Basics of Horticulture by Jitendra Singh
2. Introduction to Horticulture by N. Kumar
3. Handbook of Horticulture by ICAR.
4. Plant Tissue Culture: Basic and Applied by Timir Baran Jha and Biswajit Ghosh. Platinum Publishers. 439p.

**Elective course - 11**

S0748011 **Commercial Seed Production** **4 (3+1)**

**Objectives:**

To introduce the basic principles of planting material production at commercial scale and seed quality evaluation.

**Theory:**

General Principles of Seed Production: Raising the seed crop, Introduction, Procurement of aclass of Improved seeds, Reporting to Monitoring or certification Agency, Principles and practicesof selection of area and agronomic requirement of seed production of field crops, Importance of isolation distance and Rouging, 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.

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, Separationbased on Affinity to liquids, Seed treatment, Temperature treatment, Chemical treatment, Bagging and Labelling.

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.

Seed Certification: 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.

Seed Industry and Seed Marketing: Introduction, Evolution of the seed industry, Developmentof 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 marketingintelligence 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.

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 entrepreneurships 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.

**Suggested readings:**


1. Agarwal, R.L. 1997. Seed Technology. 2nd edn. Oxford & IBH.
2. McDonald, M.B. Jr and Copeland, L.O. 1997. Seed Production: Principles and Practices. Chapman & Hall
3. Thompson, J.R. 1979. An Introduction to Seed Technology. Leonard Hill.
4. Singhal, N.C. 2003. Hybrid Seed Production in Field Crops. Kalyani.
5. Justice, O.L. and Bass, L.N. 1978. Principles and Practices of Seed Storage. Castle House Publ. Ltd.
6. Tunwar, N.S. and Singh S.N. 1988. Indian Minimum Seed Certification Standards. CSCB, Ministry of Agriculture, New Delhi.
7. Chawla, H.S. 2008. Introduction to Plant Biotechnology. 2nd edn. Oxford &IBH publishing Co. Ltd. 113-B Shahpur Jat, New Delhi-110049.


**Elective Course 12**

S0748012 **Principles and Practices of Organic Farming and Conservation Agriculture 4(3+1)**

**Objectives:**

1. To teach students the principles of crop production under organic and conservation agriculturesituation
2. To impart practical knowledge of organic and conservation agriculture practices

**Theory**

Concept of organic farming, principles and its scope in India; Choice of crops and varietiesin organic farming; Nutrient management in organic farming and their sources; Fundamentalsof insect, pest, disease and weed management under organic mode of production; Operational structure of NPOP; Certification process and crop standards of organic farming; Processing, labelling, economic considerations and viability, marketing and export potential of organic products. Initiatives taken by Government (central/state), NGOs and other organizations for promotion of organic 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; Organic manures- recommended doses and application in comparison to inorganic fertilizers for major crops.

**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.

**Suggested readings**


1. A.C. Gaur. Handbook of Organic farming and biofertilizers.
2. A.K. Dahama. Organic Farming for Sustainable Agriculture. Agrobios (India), Jodhpur.
3. Arun. K. Sharma. Handbook of Organic Farming. Agrobios (India), Jodhpur.
4. S.P. Palaniappan and K. Annadurai. Organic Farming – Theory and Practice. Scientific Publishers. Jodhpur.
5. U. Thapa and P. Tripathy. Organic Farming in India- Problems and Prospects. Agrotech publishing agency, Udaipur.
6. G.K. Veeresh. Organic Farming. Foundation Books. New Delhi.
7. Purshit, S.S. Trends in Organic Farming in India. AgrosBios (India), Jodhpur.
1. Thampan, P.K. Organic Agriculture. Peckay tree Crops Development Foundation, Cochin,Kerala.
2. Sathe, T.V. Vermiculture and Organic Farming. Days Publishing House, New Delhi.
3. Singh, Abhinandan, Pankaj Kumar Ojha and Rahul Kumar, 2018. Conservation Agriculture Technologies. Biotech Books.
4. 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.


## Elective Course 13

S0748013 **Post Harvest Technology and Value Addition** **4 (3+1)**

**Objectives:**

1. To educate about the different pre-harvest, harvest and post-harvest factors affecting the post-harvest life of fruits and vegetables
2. To educate about preparation techniques of value-added products
3. To educate about the different dehydration techniques of horticultural crops

**Theory:**

Importance of post –harvest processing of fruits and vegetables, extent and possible causes ofpost-harvest losses: Pre-harvest factors affecting post-harvest quality, maturity, ripening and changes occurring during ripening; Respiration and factors affecting respiration rate; Harvesting and field handling; Storage (ZECC, cold storage, CA, MA and hypobaric); Value addition concept; Principles and methods of preservation; Intermediate moisture food (jam, jelly, marmalade, preserve, candy) -concepts and standards; Fermented and non-fermented beverages. Tomato products -concepts and standards; Drying /Dehydration of fruits and vegetables –concept and methods, osmotic drying. Canning – concepts and standards, packaging of products.

**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.

**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, Kounser Javeed and Abhay Kumar Sinha.Bioscientific Publishers.
3. Postharvest Technology of Horticultural Crops by K.P. Sudheer and V. Indira. New IndiaPublishing Agency. 320p.
4. Postharvest Management and Value Addition by Aswini Kumar Goel, Rajender Kumar andSatwinder S. Mann. Daya Publishing House.
5. Postharvest Management and Value Addition of Fruits and Vegetables by Kureel M.K. Biotech,181p.

## Elective course 14

**S0748014 Agricultural Journalism 4 (3+1)**

**Objectives**

To impart knowledge and skill in agricultural journalism

**Theory**

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. 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. Success storiesdefinition, 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. Use of photograph in agricultural journalism- Basic principles of photography – composition, exposure, lens, light. Use of artwork (Graphs, charts maps, etc.). Writing the captions. Editorial mechanism: Copy reading, headline and title writing. Proofreading: definition, signs and symbols of proofreading, level of proofreading, duties of a proof-reader. Layout – meaning, principles of layout and design.

**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

Suggested readings


1. Introduction to Journalism by Carole Fleming, Emma Hemmingway, and Gillian Moore.
2. Basic Journalism by Rangaswami Parthasarathy.
3. News Reporting and Editing by K. M. Shrivastava.
4. Professional Journalism by M.V. Kamath.
5. The Journalist's Handbook Book by M.V. Kamath.
6. Farm Journalism and Media Management – Bhaskaran et al.
7. Agricultural Extension and farm Journalism – A K Singh.
8. Farm Journalism – Jana and Mitra.
9. Web Materials.
10. Prepared You Tube videos


## Elective course 15

**S0748015 Climate Resilient Agriculture 4 (3+1)**

Objectives

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 inagriculture

Theory

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. Basics of adaption and mitigation 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. 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, agroadvisories, 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, 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. 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.

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.

Suggested readings


1. Climate Resilient Animal Agriculture by GSLHV Prasada Rao. New India Publishing Agency.
2. Climate Resilient Agriculture Adaptation and Mitigation Strategies by Bhan Manish. New India Publishing Agency
3. Climate-Smart Agriculture Sourcebook. FAO (2013).
4. Implications for Climate Smart Agriculture by Wahid Hasan, Sachin G. Mundhe, Abdul Majid 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. PHI Learning, 352p.
7. Climate Smart Agriculture for Sustaining Crop Productivity and Improving Livelihood Security by Prakash M. Satish Serial Publishing House.178p


## Semester VIII

| S. No | Course title | Total credits |
|---|---|---|
| 1 | For student opting 4 year BSc. (Hons.) degree<br>Student READY (RAWE) / Experiential Learning / Hands on Training / Industrial Attachment /Project Work / Internship etc. | 20 |
| | Total | 20 |

## Skill Enhancement Courses (SECs)

**SKILL ENHANCEMENT COURSE (SEC)**

A student admitted into 1st year of B.Sc. (Hons) Agriculture degree program will take 2 skill enhancement courses each of 2 credits in each semester of first year. Likewise, the student continuing his study into 2nd year of B.Sc. (Hons) Agriculture will undergo 1 skill enhancement course of 2 credits in each of the 2 semesters of 2nd year.

The student can select these courses from a bouquet of skill enhancement courses as indicatedbelow or courses offered by a college. The courses may be offered as module of complementing courses to help the student to achieve skill in a specific area of his interest.

The University/HAEIs may offer such skill enhancement courses in which it has strength/ expertise as well as there is prospect of local employment and entrepreneurship development. The courses included in the list are indicative and the University/HAEIs may add more need-based courses in the list depending on their facilities and expertise available. The students can opt only two skill enhancement courses from section I as well as section II (one from each section) in first semester. Likewise students can opt only two courses from III and IV (one from each section) in second semester, and only one course from section V as well as VI in third and fourth semester respectively.

**Indicative skill Enhancement courses**

| S. No | Section | **Course No.** | Course title | Department | Total credits |
|---|---|---|---|---|---|
| 1. | SEC-I | S0148002 | Agriculture Waste Management | Agronomy | 2 (0+2) |
| 2. | | | Organic Production Technology | Agronomy | 2 (0+2) |
| 3. | SEC-II | S0148003 | Post-harvest Processing Technology | Horticulture | 2 (0+2) |
| 4. | | | Plantation, Crop Production and Processing | Horticulture | 2 (0+2) |
| 5. | | | Commercial Horticulture | Horticulture | 2 (0+2) |
| 6. | | | Floriculture and Landscaping | Horticulture | 2 (0+2) |
| 7. | | | Protected Cultivation & Nursery Management | Horticulture | 2 (0+2) |
| 8. | SEC-III | S0248001 | Seed Production and Testing Technology | Genetics & P.B. | 2 (0+2) |
| 9. | | | Soil, Plant and Water Testing | Soil Science & Ag. Chemistry | 2 (0+2) |
| 10. | SEC-IV | S0248002 | Commercial Apiculture | Entomology | 2 (0+2) |
| 11. | | | Biofertlizer and biopesticide production | Entomology | 2 (0+2) |
| 12. | | | Production Technology of Bioagents | Plant Pathology | 2 (0+2) |
| 13. | | | Mushroom Production Technology | Plant Pathology | 2 (0+2) |
| 14. | SEC-V | S0348001 | Video Production | Ag. Extension | 2 (0+2) |

| | | | | | |
|---|---|---|---|---|---|
| 15. | | | Food Processing | A.H. & Dairying | 2 (0+2) |
| 16. | | | Basic of Agricultural Start-ups and Entrepreneurship | Ag. Economics | 2 (0+2) |
| 17. | | | Dairy Business Management | A.H. & Dairying | 2 (0+2) |
| 18. | SEC-VI | S0448001 | Poultry Production Technology | A.H. & Dairying | 2 (0+2) |
| 19. | | | Piggery Production Technology | A.H. & Dairying | 2 (0+2) |
| 20. | | | Value Added Milk Product Technology | A.H. & Dairying | 2 (0+2) |

**Course Name: Agriculture Waste Management 2 (0 + 2)**

**Course Objective:**

1. To improve students' understanding of basic food and agriculture industry waste and by-product.
2. To provide students an opportunity in understanding the significance of treating and utilizing food and agriculture waste and by-products.
3. To study effluent treatment plant.
4. The practicals provide hands-on training in different type of food and agriculture waste and by- products, further their utilization.
5. After completion of course students can apply for courses specific to any category of food waste and further specialize in it.

**Syllabus**

**The following topics are to be covered under this skill enhancement course:** Type of waste, sources, quantity generated, process of waste collection, transport systems in waste management, techniques and technologies of waste sorting. Management of waste for environmental protection and principle like RRR. Waste treatment and recycling. Identification of Agriculture wastes (plant and animal origin) – Press mud, vegetable and fruit wastes, straw of cereals, oil cakes, livestock wastes:-blood meal, horn meal, poultry liter etc. Preparation of compost:- Indore method, Bangalore method, NADEP and vermin-composting. Processing and preparation of livestock waste manures. Analysis of nutrient contents and heavy metals in plant and animal waste. Prevention of waste origin through cleaner production, ecologically friendly products. Waste Act, implementing regulations.

**Practicals:**

1. Identification of waste from agriculture and food processing (Dairy/ Meat/ Fruits/ Vegetables / Alcoholic beverages/ cereals).
2. Study and layout of waste water treatment system (ETP).
3. Identification of co-products from Food &Vegetable industry, estimation and utilization to develop value added products (pectin, banana fiber, lycopene from tomato waste, watermelon/pumpkin rind).
4. Identification of waste from animal industry and utilization to develop value added products (gelatin, egg shell).

**Organic Production Technology** 2 (0 + 2)

**Course Objective:**

**1.** To Acquire knowledge on concepts of organic agriculture and have knowledge of conserving environment and natural resources, re- establishing.

**2.** To gain the information about the impact of organic farming and indigenous practices on environment, ecological balance, and encouraging sustainable agriculture.

**3.** To have knowledge of Improving soil fertility, conserving flora and fauna, improving genetic diversity.
**4.** To produce food of high nutritional quality in sufficient quantity.
**5.** Understand the procedure followed for organic certification as per NPOP guidelines namely production standards, labelling and accreditation.
**6.** To understand the economics of organic farming.

**Syllabus**

**The following topics are to be covered under this skill enhancement course on organic production technology:** Introduction, Concept/ Philosophies, Principles and Need of organic farming, Package of Practices for organic Farming: Selection of Crop, Seed selection and Treatment, Soil Sampling, Weed Management & Irrigation Management, Soil Nutrient Management: Establishment of Organic Nutrient Production Unit (Manures, Compost and Bio fertilizer), Integrated Pest and Disease Management under Organic Farming including Integrated Pest Management: Bio pesticides and their Multiplication, Production of Bio and Herbal Pesticides at household/ Farm Level, Harvest and Post-Harvest Management: Branding of rural products, FSSAI, marketing and packaging of organic produce, Undertake Business of Organic Farming, Various Current Government schemes related to organic farming & Process of Inspection, Certification and Labelling, Marketing and export of organic produce.

**Practicals:**

**1.** Visit to Organic farm to study the various components, identification and utilization of Organic products.
**2.** Preparation of Organic Compost — Over ground compost, Pit compost, Liquid compost, Vermi compost.
**3.** Preparation of Neem products and other botanicals for Pest and disease control.
**4.** Weed control through organic way.
**5.** Soil analysis: pH determination.
**6.** Seed bed preparation, seed selection and seedling preparation.
**7.** Method of application of different types of fertilizer and Green manure.
**8.** Preparation of Panchagavya / Amrit Jol.

**Suggested readings:**


1. Sharma, Arun K. (2002). *A Handbook of Organic Farming.* Agrobios, India.
2. Sathe, T.V. (2004). *Vermiculture and Organic Farming.* Daya Publishers.
3. Alvares, C. (1996). *The Organic Farming Source Book.* The Other India Press, Mapusa, Goa.
4. Gupta, M. (2004). *Organic Agriculture Development in India.* ABD Publishers, Jaipur, India.
5. S.P. Palaniappan & K. Annadurai (1999). *Organic Farming - Theory and Practice.* Scientific Publishers, Jodhpur, India.
6. Dr. Pratiksha Raghuvanoki. *Handbook of Organic Farming.*
7. *Organic Farming: The Ecological System* – Agronomy Monograph 54, ASA, USA.
8. Subha Rao, N.S. (2000). *Soil Microbiology.* Oxford & IBH Publishers, New Delhi.
9. Dongarjal R.P. & Zade S.B. (2019). *Insect Ecology and Integrated Pest Management.* Akinik Publications, New Delhi.
10. *Guideline of National Project on Organic Farming*, Department of Agriculture and Cooperation, INM Division, Ministry of Agriculture, Govt. of India.
11. Dushyent Gehlot (2005). *Organic Farming – Standards, Accreditation, Certification and Inspection.* Agribios, India.


**Post-harvest Processing Technology** 2 (0 + 2)

**Course Objectives:**

1. To provide basic understanding/knowledge of postharvest processing methods and processes involved in post harvest loss reduction.

2. To introduce postharvest management practices which are eco-friendly and sustainable by integrating them with existing modern technologies.
3. To encourage students in product development, conversion of fresh produce to processed form for value addition (nutritive and economic value).

**Syllabus:**

**The following topics are to be covered under this skill enhancement course on post - harvest processing technology:** Importance of fruits and vegetables, extent and possible causes of post harvest losses, role of postharvest technology, Climatic factors, Plant factors and Field Management factors Biochemical changes: cell wall changes, TSS, Acidity and Sugar changes, changes in Flavour compounds, Physiological Changes: Respiration and factors effecting respiration, Ethylene production. Harvesting: Different types of harvesting and their advantages, Pachouse operations: washing, grading, waxing, postharvest treatments, packaging and Storage: (ZECC, cold storage, CA, MA, and hypobaric storage); Heat, chilling and freezing injury. Value addition concept; Principles and methods of preservation: Irradiation, Pastuerization, Sterilization, Carbonation Prepartion of Jam, jelly, marmalade, preserve, candy – Concepts and Standards. Fermented beverages: Preparation of wine and cider, other fermented products prepared from fruits; Unfermented beverages: Preparation of RTS, Syrup, Squash, cordial. Tomato products-preparation sauce, ketchep, soup, paste/puree, Chutney; Drying– difference between drying and dehydration and their concepts, different methods of drying: solar drying, osmotic drying, shade drying; Different types of dryers: Spray, cabinet, Fluidized bed dryer; Canning- Concepts and Standards, preparation of canned products, packaging of products.

**Practicals:** Preparation of Jam, Preparation of jelly, marmalade, Preparation of preserve, Preparation of candy, Preparation of Fermented beverages (wine and cider), Preparation of Unfermented beverages (RTS, Syrup, Squash, cordial), Preparation of sauce, ketchep, soup, paste/puree etc.

**Suggested readings:**


1. R.Verma and V.K.Joshi. 2000. Post Harvest Technology of Fruits and Vegetables. Vol. I & II Indus Publishing Co. New Delhi ISBN 81-7387-108-6.
2. Ron Wills, Mc Glasson and Graham Joyce. 2007. Postharvest- An Introduction to the Physiology and Handling of Fruits, Vegetables and ornamentals. Cab International. ISBN97818459322755.
3. K. Thomposon. 1996. Post Harvest Technology of Fruits and Vegetables. Blackwell Science ISBN 1-4051-0619-0.
4. Stanley J. Kays. 1998. Post Harvest Physiology of Perishable Plant Products. CBS, New Delhi.
5. Lisa Kitinoja and Adel A. Kader. 2002. Small-Scale Postharvest Handling Practices: A Manual for Horticultural Crops (4th Edition) P ostharvest Horticulture Series No. 8E Postharvest Technology Research and Information Center University of California, Davis USA.


**Plantation Crops, Production and Processing 2 (0 + 2)**

**Course Objectives:**

1. Understand the importance and scope of plantation crops
2. Learn about the production practices and challenges of major plantation crops
3. Familiarize with the processing and value addition of plantation crops
4. Develop skills in plantation crop management and processing

**Syllabus:**

**The following topics are to be covered under this skill enhancement course on plantation crops, production and processing:** Introduction-Definition, role of plantation crops in National economy; Area, production, productivity, export and import; Centre of origin, Botanical characteristics, classification and varietal wealth. Soil and climatic factors on crop

growth and productivity, their problems; Plant propagation, planting and after care, bringing to bearing; nutritional management-macro and micro nutrients, deficiency symptoms, physiological disorders, role of growth regulator, water requirements, fertigation, water management- drainage and irrigation, shade regulation, weed management, training and pruning, crop regulation, maturity indices, harvesting. Uprooting and replanting; various production problems- weeds, pests and diseases, their management; Multitier cropping, photosynthetic efficiencies of crops at different tiers, cost benefit analysis; Organic farming, management of drought, precision farming. Introduction, principles and practices of post-harvest technology of plantation crops, commercial uses of plantation crops. Processing of major produce from plantation crops, processing and value addition, grading, packing and storage. **Crops:** Tea, Cocoa, Rubber, Coconut, Betel vine, Coffee, cashew nut, Areca nut and Oil palm..etc. Cost analysis and establishment of enterprise based on this skill enhancement course.

**Practicals:** Description of botanical and varietal features, selection of elite/ mother plants and seedlings, soil test crop response studies and manuring practices, pruning and training, maturity standards, harvesting, Project preparation for establishing nursery and plantations, visit to plantation. : Identification of seeds and plants, botanical description of plant; preparation of herbarium, propagation, nursery raising, field layout and method of planting, cultural practices, harvesting. Study of processing of different plantation crops and storage. Value added products from plantation crops.

**Suggested readings:**

1. Plantation Crops Production and Processing by S. K. Singh
2. Tea Production and Processing by R. K. Gupta
3. Coffee Production and Processing by T. K. Bose
4. Plantation Crops: A Comprehensive Treatise by various authors
5. Tea Science and Technology by various authors
6. Coffee Science and Technology by various authors
7. Cocoa Production and Processing by various authors
8. Rubber Production and Processing by various authors

**Commercial Horticulture 2(0+2)**

**Course Objectives:**

1. Understand the fundamentals of commercial horticulture and its importance in agriculture.
2. Learn about the production, management, and marketing of horticultural crops.
3. Familiarize with the latest technologies and innovations in commercial horticulture.
4. Develop skills in planning, managing, and evaluating commercial horticulture enterprises.

**Syllabus:**

**The following topics are to be covered under this skill enhancement course on commercial horticulture: Introduction to Commercial Horticulture:** - Definition, scope, and importance of commercial horticulture - History and development of commercial horticulture- Role of commercial horticulture in agriculture and economy, Production Management: - Principles of crop selection, planning, and management - Soil and climate requirements for horticultural crops - Irrigation, fertilization, and pest management practices, Fruit Production - Commercial fruit crops (e.g., mango, banana, citrus) - Propagation, pruning, and training methods - Harvesting, handling, and storage techniques, Vegetable Production - Commercial vegetable crops (e.g., tomato, potato, onion) - Seed production, nursery management, and transplanting - Crop rotation, intercropping, and succession planting, Ornamental Horticulture - Commercial ornamental crops (e.g., rose, chrysanthemum, carnation) - Propagation, pruning, and training methods - Post-harvest handling and marketing, Marketing and Entrepreneurship - Market trends, demand, and supply analysis - Marketing strategies and channels (e.g., wholesale, retail, online) - Entrepreneurship development and business planning, Latest Technologies and Innovations - Precision horticulture, hydroponics, and vertical farming - Protected cultivation, greenhouses, and shade houses - Mechanization and automation in horticulture, Case Studies and Project Planning- Real-life case studies of successful commercial horticulture enterprises - Project planning, feasibility studies, and risk assessment. Cost analysis and establishment of enterprise based on this skill enhancement course.

**Practicals:**

1. Visit to Commercial Horticulture Farms: Visit local commercial horticulture farms to observe production practices, marketing strategies, and management techniques.
2. Soil Testing and Analysis: Conduct soil tests to determine pH, nutrient levels, and other parameters essential for horticultural crop production.
3. Propagation Techniques: Practice propagation techniques for horticultural crops, including grafting, budding, and layering.
4. Pruning and Training: Learn pruning and training techniques for fruit trees, ornamental plants, and other horticultural crops.
5. Irrigation System Design: Design and install irrigation systems for horticultural crops, including drip irrigation and sprinkler systems.
6. Pest and Disease Management: Identify common pests and diseases affecting horticultural crops and learn management strategies.
7. Post-Harvest Handling: Practice post-harvest handling techniques, including grading, packaging, and storage of horticultural produce.
8. Market Survey: Conduct a market survey to analyze demand, supply, and prices of horticultural produce.
9. Business Plan Development: Develop a business plan for a commercial horticulture enterprise, including production, marketing, and financial projections.
10. Case Study Analysis: Analyze case studies of successful commercial horticulture enterprises to identify best practices and challenges.

**Suggested readings:**

1. Commercial Horticulture by T. K. Bose
2. Horticulture: Principles and Practices by G. L. Kohli
3. Fruit Production and Postharvest Management by S. K. Mitra
4. Vegetable Production and Postharvest Handling by R. K. Singh
5. Ornamental Horticulture by R. L. Misra
6. Precision Horticulture by A. K. Singh

**Floriculture and Landscaping** **2 (0+2)**

**Course Objectives:**

1. Understand the fundamentals of floriculture and landscaping.
2. Learn about the production, management, and marketing of floricultural crops.
3. Familiarize with the principles and practices of landscaping, including design, installation, and maintenance.
4. Develop skills in creating and maintaining beautiful and functional landscapes.

**Syllabus:**

**The following topics are to be covered under this skill enhancement course on floriculture and landscaping; Introduction to Floriculture** - Definition, scope, and importance of floriculture - History and development of floriculture industry - Types of floricultural crops (e.g., cut flowers, potted plants, bedding plants). Production Management - Principles of crop selection, planning, and management - Soil, climate, and irrigation requirements for floricultural crops - Propagation, growth regulation, and pest management practices**.** Floricultural Crops - Production and management of specific floricultural crops (e.g., rose, carnation, chrysanthemum) - Post-harvest handling and marketing of floricultural products**.** Landscaping Principles - Definition, scope, and importance of landscaping - Principles of landscape design (e.g., balance, proportion, harmony) - Types of landscapes (e.g., residential, commercial, public)**.** Landscaping Design and Installation - Landscape design process (e.g., site analysis, concept development, plan preparation) - Installation of landscape features (e.g., plants, hardscapes, water features)**.** Landscape Maintenance - Maintenance practices for landscapes (e.g., pruning, irrigation, fertilization) - Pest and disease management in landscapes**.** Specialized Landscaping - Specialized landscaping techniques (e.g., xeriscaping, vertical gardening) - Use of ornamental plants in landscaping (e.g., trees, shrubs, groundcovers)**.** Trends and Innovations - Current trends and

innovations in floriculture and landscaping (e.g., sustainable practices, technology integration). Cost analysis and establishment of enterprise based on floriculture and landscaping.

**Practicals:**

1. Propagation of Floricultural Crops: Practice propagation techniques for floricultural crops, including seed sowing, cutting, and grafting.
2. Floricultural Crop Production: Learn production techniques for specific floricultural crops, including rose, carnation, and chrysanthemum.
3. Post-Harvest Handling: Practice post-harvest handling techniques for cut flowers, including grading, packaging, and storage.
4. Floral Arrangement: Create floral arrangements using various flowers, foliage, and design principles.
5. Market Survey: Conduct a market survey to analyze demand, supply, and prices of floricultural products.
6. Landscape Design: Create landscape designs for residential or commercial spaces, including plant selection and layout.
7. Plant Selection and Identification: Identify and select ornamental plants suitable for landscaping, including trees, shrubs, and groundcovers.
8. Landscape Installation: Practice installing landscape features, including plants, hardscapes, and water features.
9. Landscape Maintenance: Learn maintenance practices for landscapes, including pruning, irrigation, and fertilization.
10. Xeriscaping and Sustainable Landscaping: Design and install xeriscapes or sustainable landscapes using drought-tolerant plants and efficient irrigation systems.

**Suggested readings:**


1. Floriculture: Principles and Practices by S. K. Singh
2. Floriculture and Landscaping by T. K. Bose
3. Commercial Floriculture by R. K. Singh
4. Floriculture: A Comprehensive Guide by G. L. Kohli
5. Cut Flower Production and Management by A. K. Singh
6. Landscaping: Principles and Practices by R. L. Misra
7. Landscape Design and Installation by A. K. Singh
8. Sustainable Landscaping by S. K. Mitra
9. Landscape Architecture: A Manual of Environmental Design by L. J. Simas
10. Principles of Landscape Design by T. K. Bose
11. The Art of Floral Design by various authors
12. Landscape Plants for Dry Regions by E. F. Gilman
13. Floriculture and Landscaping: A Practical Guide by various authors
14. Sustainable Landscaping for Dummies by various authors
15. The Landscape Architect's Handbook by various authors


**Course Title:** Protected Cultivation and Nursery Management **Course Code:** S0148003
**Course Credits:** 2 (0+2)

**Course Objectives:**

1. Understand the principles and benefits of protected cultivation
2. Learn greenhouse management practices, including climate control and irrigation systems
3. Familiarize with hydroponics and other soilless cultivation methods
4. Develop skills in nursery management, including plant propagation and production
5. Analyze case studies and develop business plans for protected cultivation and nursery enterprises

**Syllabus:**

**The following topics are to be covered under this skill enhancement course on protected cultivation and nursery management:** Introduction to Protected Cultivation- Definition, scope, and importance of protected cultivation, Types of protected cultivation structures (e.g., greenhouses, polyhouses, shade houses), Benefits and limitations of protected

cultivation. Greenhouse Management, Greenhouse design and construction, Climate control systems (e.g., heating, cooling, ventilation),Irrigation and fertigation systems Crop selection and management in greenhouses. Hydroponics and Soilless Cultivation Principles and benefits of hydroponics Types of hydroponic systems (e.g., NFT, DFT, ebb-and-flow) Nutrient management and plant growth in hydroponic systems. Nursery Management Principles and practices of nursery management Plant propagation methods (e.g., seed, cuttings, grafting)**,** Nursery production systems (e.g., container, field)**,** Plant growth regulation and pest management in nurseries. Business Planning and Entrepreneurship Market analysis and demand for protected cultivation and nursery products, Business planning and financial management for protected cultivation and nursery enterprises, Marketing and sales strategies for protected cultivation and nursery products.

**Practicals:**

1. Greenhouse Visit and Observation: Visit a greenhouse and observe climate control systems, irrigation systems, and crop management practices.
2. Greenhouse Design and Layout: Design and layout a greenhouse, including climate control and irrigation systems.
3. Hydroponic System Setup: Set up a hydroponic system, including nutrient solution preparation and plant placement.
4. Crop Selection and Planting: Select and plant crops suitable for protected cultivation, including vegetables, fruits, and flowers.
5. Climate Control and Irrigation Management: Manage climate control and irrigation systems in a greenhouse or protected cultivation structure.
6. Nursery Visit and Observation: Visit a nursery and observe plant propagation, production, and management practices.
7. Seed Germination and Seedling Production: Practice seed germination and seedling production techniques.
8. Plant Propagation Methods: Practice plant propagation methods, including cuttings, grafting, and layering.
9. Container and Field Nursery Production: Practice container and field nursery production techniques.
10. Plant Growth Regulation and Pest Management: Practice plant growth regulation and pest management techniques in a nursery setting.

**Suggested readings:**

1. Protected Cultivation and Nursery Management by S. K. Singh
2. Greenhouse Management by R. K. Gupta
3. Hydroponics: A Practical Guide by T. K. Bose
4. Nursery Management: Principles and Practices by G. L. Kohli
5. Protected Cultivation of Horticultural Crops by various authors
6. Greenhouse Production and Management by various authors
7. Hydroponic Crop Production by various authors
8. Nursery Production and Management by various authors

**Seed Production and Testing** **2(0 + 2)**

**Course Objective:**

1. Seed Production: Understanding Seed Biology, Seed Production Techniques, Quality Control, and Seed Certification.
2. Seed Testing: Quality Assessment, Sampling Techniques, Seed Health Testing, and Seed Storage and Preservation.
3. Seed Processing: Understanding Processing Methods and Quality Control.

**Syllabus:**

**The following topics are to be covered under this skill enhancement course on seed production and testing technology:** Definitions: Seed, seed quality, certified seed, etc. Importance and scope of seed industry in India. Classes of seed and their production chain. Genetic and physical purity. Isolation distance, agronomic management, rouging. Field inspections and

seed certification standards. Seed processing steps: drying, cleaning, grading, treating. Equipment used in seed processing plants. Seed packaging and storage principles. Seed deterioration and methods to maintain seed viability. Seed sampling procedures. Testing for purity, germination, moisture, and seed health. Field Inspection- principles, phases and procedures; reporting and evaluation of observations; pre and post-harvest control tests for genetic purity evaluation (grow-out tests); post harvest inspection and evaluation; seed sampling, testing, labeling, sealing and grant of certificate; types and specifications for tags and labels; maintenance and issuance of certification records and reports; certification fee and other service charges; training and liaison with seed growers. OECD seed certification schemes. ISTA and national seed testing rules. Seed Act (1966), Seed Rules (1968), Seed Control Order. Role of central/state seed certification agencies and seed inspectors. Intellectual Property Rights (IPR), PPV&FR Act.

**Practicals:** Selection of suitable areas/locations for high quality seed/planting material production; study of floral biology of vegetables, determination of planting ratios for hybrid seed production vegetables; use and maintenance of monoecious line in hybrid seed production of cucumber; exercises on emasculation and pollination; seed extraction methods and their effect on quality of vegetables; seed production technology of varieties and hybrids in vegetables. Structure of monocot and dicot seeds of important plant species; identification and handling of instruments used in seed testing laboratory; identification of seeds of weeds and crops; physical purity analysis of samples of different crops; estimation of seed moisture content (oven method); seed dormancy breaking methods requirements for conducting germination test, specifications and proper use of different substrata for germination; seed germination testing in different agri-horticultural crops; seedling evaluation; viability testing by tetrazolium test in different crops; seed and seedling vigour tests applicable in various crops; species & cultivar identification; genetic purity testing by chemical, biochemical and molecular methods; seed health testing for designated diseases, blotter methods, agar method and embryo count methods; testing coated/pelleted seeds.

**Suggested readings:**


1. Agrawal PK. (Ed.). 1993. Handbook of Seed Testing. Ministry of Agriculture, GOI, New Delhi.
2. Agrawal, R.L. 1975. Beej utpadan Evam Pramanikaran (Hindi). G.B.Pant Univ. of Ag. & Tech. Pantnagar.
3. Agrawal, R.L. 1997. Seed Technology (IInd Ed.) Oxford & IBH Publ. Co. New Delhi.
4. ANON. 1996. International rules for seed testing. Seed Science and Technology, 24 (suppl):1-335
5. AOSA. 1991.Cultivar purity testing handbook. Contribution no.33 to the Handbook on seed testing (MB McDonald & R. Payne, eds.) Assn. of Official Seed Analysts, Linkon.
6. Arora, S.K. Hariyana Men Subjion ki Utpadan Prodhyokiki. Scientific Pub. India.
7. Chalam, G.V and L. Neelkantam 1962. Improved Seed. Agricultural Production Manual,
8. Copland LO & McDonald MB. 1996. Principles of Seed Science and Technology. Kluwer.
9. Desai BB, Katecha, PM & Salunke DK.1997. Seed Hand Book: Biology, Production.
10. Desai BB. 2004. Seeds Handbook. Marcel Dekker.
11. F.A.O. Quality declared seeds 1997. (United Nations Rome.) Daya Publ. House.
12. George RAT. 1980. Vegetable Seed Technology. A Technical Guide to Vegetable Seed.
13. Harihar Ram. (1997). Vegetable Breeding; Principles and Practices. ICAR. New Delhi.ed. Chapman and Hall, New York.
14. ISTA (1983). Seed Technology in the tropic. The International Seed Testing Association, reprinted by Scientific Publishers, India.
15. ISTA 2006. Seed Testing Manual. ISTA, Switzerland.
16. ISTA(2008) International Rules For Seed Testing.ISTA, Bassersdrof, CH. Switzerland.
17. Martin C & Barkley D. 1961. Seed Identification Manual. Oxford & IBH.
18. Nema, N.P. Principles of Seed Certification and Testing. Daya Publ. House.
19. Seed Act, 1966. Govt. of India, Manager Publications, G.I.O., New Delhi.
20. Seed Rules, 1968. Govt. of India, Manager Publications, G.I.O., New Delhi.
21. Singh SP. 2001. Seed Production of Commercial Vegetables. Agrotech.

22. Tunwar NS & Singh SV. 1988. Indian Minimum Seed Certification Standards. Central Seed Certification Board, Ministry of Agriculture, New Delhi.

**Soil, Water and Plant Analysis** **2(0 + 2)**

**Course Objective:**

1. To Evaluate Soil Fertility, Assessment of Soil Suitability, Identification of Soil Problems, and Recommendation of Management Practices.
2. To Evaluate Water Quality and Determination of Irrigation Needs.
3. To Diagnose Nutrient Deficiencies and Evaluate Plant Response to Nutrients.
4. To understand the composition, properties, and interactions of soil, water, and plants, enabling them to make informed decisions for sustainable agricultural practices.

**Syllabus:**

**The following topics are to be covered under this skill enhancement course on soil, water and plant analysis:** Collection and soil water and plant sample for analyses; Soil profile study; Bulk density, particle density, porosity, water holding capacity and soil texture; Estimation of soil moisture by gravimetric and volumetric methods; Lime requirement, Organic carbon, pH, EC and available major and micronutrient in soil and plant sample; Leaf area by leaf area meter; Relative water content of leaf; Specific leaf weight; Chlorophyll content of leaf, Irrigation water quality analysis; Measurement of soil water potential; Water flood measurement. Seed viability and germination testing.

**Practicals:** Study of soil sampling tools, collection of representative soil sample, its processing and storage, Determination of bulk density and particle density of soil by pycnometer method, Determination of Porosity and moisture content in soil, Determination of soil pH, electrical conductivity, Cation Exchange Capacity of soil, Estimation of organic carbon and organic matter content in soil, Estimation of Mineralizable Nitrogen in Soil, Estimation of Available Phosphorus in Acid Soil andAlkaline soil, Estimation of available Potassium, Ca and Mg, Sulphur in soils, Estimation of Total Nitrogen, Phosphorus, Potassium, and Sulphur in plants, Collection of Water Samples and Estimation of irrigation water pH, Electrical Conductivity (EC), Total Dissolved Solids (TDS), Total Suspended Solids, Biological Oxygen Demand, different forms of Nitrogen, different forms of Phosphorus, Potassium, Chlorides, Carbonate and Bicarbonate, Sulphate, Boron, Sodium, Calcium and Magnesium and Estimation of Water quality indices and suitability. Determination of soil texture and Soil Suction. Testing of Seed Viability, Seed Germination Test, Seed Physical Purity Test, Electrical conductance of seed leachate, Determination of test weight, Introduction to GIS and RS software: downloading ,installation, plugins, Geo-referencing of a toposheet in GIS software, Digitization and area calculation using GIS software, Field data collection using GPS device and data import to QGIS, Collection of open source satellite data and DEM ,Rainfall data, and Soil Map, Creation of different types of map in GIS Software, Soil Erosion Risk mapping using RUSLE MODEL.

**Suggested readings:**

1. Dhyan Singh, P. K. Chhonkar, and B. S. Dwivedi. 2013. Manual on soil, water and plant analysis. Westville Publishing House, New Delhi.

2. George Estefan, Rolf Sommer, and John Ryan . 2013. *Methods of Soil, Plant, and Water Analysis.*International Center for Agricultural Research in the Dry Areas) Box 114/5055, Beirut, Lebanon
3. Methods of Soil Analysis: Part 1 and 2" *Editors: C.A. Black, D.D. Evans, J.L. White, L.E. Ensminger, and F.E. Clark.* Publisher: American Society of Agronomy.
4. Lindsay, W. L., & Norvell, W. A. (1978). *"Development of a DTPA Soil Test for Zinc, Iron, Manganese, and Copper."Soil Science Society of America Journal, 42(3), 421–428.* DOI: 10.2136/sssaj1978.03615995004200030009x

5. Chapman, H. D., & Pratt, P. F. (1961).*"Methods of Analysis for Soils, Plants and Waters."* University of California, Division of Agricultural Sciences.
6. APHA (American Public Health Association). *"Standard Methods for the Examination of Water and Wastewater."*
7. ICAR – Indian Council of Agricultural Research (India). Offers soil and plant testing manuals in PDF format from institutes like IISS (Bhopal) and CSSRI.
8. FAO Soil and Plant Testing Manuals. Accessible at: www.fao.org
9. "Soil Chemical Analysis"*Author: Subbiah Asija / Jackson, M.L.*Publisher: Prentice Hall
10. "Handbook of Reference Methods for Plant Analysis" *Editor: Yash P. Kalra.* Publisher: CRC Press
11. "Soil, Plant and Water Analysis: A Methods Manual". *Authors: S. R. Reddy & P. R. Reddy*
12. "Water Quality: Guidelines, Standards and Health**".***World Health Organization (WHO)*

**Commercial Apiculture** **2 (0 + 2)**

**Course Objective:**

**1.** To promote the public awareness of beekeeping and native honeybees for the improvement crop yield.
**2.** Explain the basic concepts of apiculture like systematic, colony organization, polymorphism, morphology and foraging.
**3.** Producing other honeybee substances, including bee pollen, propolis, and royal jelly.
**4.** To provide Knowledge of honeybee biology, Knowledge of local nectar flows, Deciding on the goals and how to best use the colonies.
**5.** To build human resource in the beekeeping sector.
**6.** To justify the presence of bees to increase the agriculture productivity.
**7.** To control quality and promote markets of honeybee products.
**8.** To establish small scale agriculture based industry.
**9.** To provide pollination services for local food crops.
**10.** To co-operate with other Bee-Keeping organizations with similar aims.

**Syllabus**

**The following topics are to be covered under this skill enhacement course on Commercial Apiculture:** Theory: Introduction to Apiculture: Scope, importance, history of bee keeping, Types: Traditional bee keeping, Modern beekeeping, Urban or backyard beekeeping, Apiculture development in India: institutions involved. Role of Central Honey Bee Research & Training Institute, Basic Taxonomy: Honey bee species and identification. Origin, systematic and distribution of honey bees. Types of honey bees, Species of honey bees. Bee identification , Basic concepts of morphology of Honey bees – indigenous and exotic, Social organization in honey bees, Social behaviour and Communication, Basic requirements of Tools for starting bee keeping, Bee flora, importance propagation, congenial conditions for starting up of apiculture, Migratory Bee Keeping: transportation of Colonies, floral Calendar designing, Bee breeding multiplication of colonies, Production of Honey and ther valuable by products of honey bees, Honey extraction & handling - Quality control standards - Honey testing kit, Processing of honey, Bee venom & Royal jelly extraction, Bee venom & Royal jelly extraction, Seasonal Management of bee colonies, Bee as pollinators, types of crop pollinated by bees, Bee enemies and diseases: Introduction, Enemies of honeybees – Wax Moth, Ants, Wasps, Microbes, Pests; Diagnosis and identification and their management, Economics in small scale and large scale bee keeping, Types of value added honey products Marketing of bee products: Definition of marketing, Marketing Honey Comb and Honey, Marketing Pollination Services, Marketing Wax, Marketing Propolis, Marketing Pollen, Marketing Royal Jelly, Marketing Bee Venom, Marketing Adult and Larval bees, Costing and Financing the Marketing Activities, Beekeeping as small scale agriculture industry.

**Practicals:** Study of morphology and anatomy of honey bee, Identification of different species and sub-species of honeybees, To become familiar with different equipments used in modern beekeeping for domesticating hive bees, basic principles of honey bee management , parameters required for selection of good apiary site, andling of bee colonies, recording of colony data and precautions required, supplementary feeding, robbing, absconding, and honey extraction, management practices

required for scientific management of honey bee colonies, method of honey extraction and preparing colonies for summer season, To understand technique of mass queen rearing of honey bees, important bee enemies and their management, honey bee diseases, their symptoms and management, study of Bee products, Honey extraction, processing, bottling, Bees wax rendering, Royal jelly preparation, Bee pollen, propolies extraction and Value added honey product preparation, purification, To know expenditure involved and income generation from commercial bee keeping, To understand Economic Value of Commercial Beekeeping.

**Suggested readings:**


1. ABC & XYZ of Bee culture - A. I. Root
2. Alethea Morrison (Author), Mars Vilaubi (Photographer), 2013. Homegrown Honey Bees: An Absolute Beginner's Guide to Beekeeping Your First Year, from Hiving to Honey Harvest. Storey Publishing, LLC; 1 edition.
3. Alison Benjamin, By (author) Brian McCallum, 2008. Keeping Bees and Making Honey. David & Charles, Newton Abbot.
4. Alison Benjamin, By (author) Brian McCallum, 2008. Keeping Bees and Making Honey. David & Charles, Newton Abbot.
5. Asian Bee Journal Bee Keeping in India - G. K. Ghosh
6. Beekeeping: A personal journey – Dennis Brown Craig Hughes, 2010. Urban Beekeeping: A Guide to Keeping Bees in the City. e Good Life Press, Preston.
7. David Cramp, 2009. A Practical Manual of Beekeeping: How to Keep Bees and Develop Your Full Potential as an Apiarist. Spring Hill, London.
8. David Cramp, 2012. The Complete Step-by-step Book of Beekeeping: A Practical Guide to Beekeeping, from Setting up a Colony to Hive Management and Harvesting the Honey. Lorenz Books. London.
9. Dewey M. Caron, 2013. Honey Bee Biology and Beekeeping, Revised Edition. Wicwas Press, Kalamazoo.
10. Eva Crane, 1999. The World History of Beekeeping and Honey Hunting. Routledge, India.
11. Hunt, G.J., 2000. Using honey bees in pollination Purdue University.
12. Indian Bee Journal - All India Bee Keeping Association
13. Kim Flottum, 2014. The Backyard Beekeeper: An Absolute Beginner's Guide to Keeping Bees in Your Yard and Garden. Quarry Books.
14. Kim Pezza, 2013. Backyard Farming: Keeping Honey Bees: From Hive Management to Honey Harvesting and More. Hatherleigh Press, U.S.
14. Laidlaw, H.H., 1997. Contemporary queen rearing. Published by Dadant and Sons. R. A. Morse, Rearing queen honey bees. Wicwas press, NY.


**Biofertilizers and Biopesticides Production** **2 (0 + 2)**

**Course Objective:**

1. To provide foundational knowledge of biofertilizers and biopesticides, including their types, production methods, and mechanisms of action.
2. To understand the role of beneficial microorganisms in soil fertility, plant growth promotion, and pest and disease control.
3. To explore the ecological and environmental benefits of using biofertilizers and biopesticides as alternatives to chemical inputs in agriculture.
4. To develop skills for the isolation, identification, and mass production of microbial agents used in biofertilizers and biopesticides.
5. To examine current trends, regulatory frameworks, and commercialization strategies for biofertilizer and biopesticide products.
6. To encourage the adoption of sustainable and eco-friendly agricultural practices through practical knowledge of microbial formulations and field applications.
7. To evaluate the efficacy and field performance of different biofertilizers and biopesticides through experimental and case study approaches.

**Syllabus:**

**The following topics are to be covered under this skill enhacement course on Biofertilizers and Biopesticides Production:** Definition, history, types need, scope, advantages, limitations and necessity of biofertilizers and biopesticides. Introduction to vermiculture. Definition, meaning, history, economic important, their value in maintenance of soil structure, role as four R's of recycling, reduce, reuse, recycle, restore. Small Scale Vermicompost Technology by Earthworm farming for home gardens – Earthworm compost for home gardens. Vermiwash collection, composition & use. Algal biofertilizers – Blue green algae-distribution-occurrence. Azolla-Anabaena symbiosis-Importance- Azolla growth behavior, multiplication- sporulation etc.

**Practicals:**

1. Preparation of culture media for microorganisms.
2. Screening of microorganisms from soil and root nodules by pour plate method.
3. Isolation of Rhizobium from root nodules.
4. Isolation of Azotobacter from rhizosphere soil.
5. Qualitative estimation of Phosphate Solubilising Bacteria from soil.
6. Qualitative estimation of Potassium solubilising bacteria.
7. Isolation of *Bacillus thuringiensis* from soil.
8. Preparation of Algal Biofertilizer.
9. Study of Vermiculture, Vermiwash & Vermicompost equipments, devices.

**Suggested readings:**

1. Kannaiyan, S. (2003). Biotechnology of Biofertilizers, CHIPS, Texas.
2.Mahendra K. Rai (2005). Hand book of Microbial biofertilizers, The Haworth Press, Inc. New York.
3. Reddy, S.M. et. al. (2002). Bioinoculants for sustainable agriculture and forestry, Scientific Publishers.
4. Subba Rao N.S (1995) Soil microorganisms and plant growth Oxford and IBH publishing co. Pvt. Ltd. NewDelhi.
5. Saleem F and Shakoori AR (2012) Development of Bioinsecticide, Lap Lambert Academic Publishing Gmb HKG.

**Production Technology of Bioagents** **2 (0 + 2)**

**Course Objective:**

1. To gain the knowledge of production of Bioagents.
2. To assess the importance of bioagents use
3. To know about how environment can be sustained by bioagents .
4. To learn how to create wealth from Bioagents.
5. To set up bioagent production unit and its cost analysis.

**Syllabus:**

**The following topics are to be covered under this skill enhancement course on production technology of bioagents:** Introduction and types and importance of bioagents in agriculture and organic farming system. History and Classification of bioagents. .Quality standard for bioagents, ifferent methods of application of bioagents, methods of quality control assessment in respect of bioagents, Strategies of Mass multiplication and packing, registration of bioagents. Strategies of marking and Registration with CIB of bioagents. Importance of Trichoderma spp., Pseudomonas spp. and Bacillus spp. as a biocontrol agents,Mechanism of disease control by thses organisms bioagents .Types of diseases controlled bioagents formulations, Effectiveness of bioagents against seed borne and soil borne plant pathogens, Mass multiplication and packing , Strategies of marking, and Registration with CIB and organic farming institute. Importance of Trichogramma, Cryptolaemus, Chrysoperla, NPV and entomofungal pathogens. Establishing insectary for host insects and natural enemies, Mass production of Verticillium/Beauveria/Metarhzium/Nomuraea/Paecilomyces/Hirsutella thompsoni/Trichoderma, / Pseudomonas/Bacillus/Potash Mobilizers/Sulphur oxidizers /organic matter decomposers.

**Practicals:-** Equipment, machinery and tools used for production of bioagents, Preparation of media used for isolation and culturing of bioagents, isolation and mass production of richogramma, Cryptolaemus, Crysoperla,Mass HaNPV, and EPN. Importance of Verticillium/Beauveria/ Metarhzium/Nomuraea/ Paecilomyces/Hirsutella thompsoni/ Trichoderma,/ Pseudomonas/Bacillus/ organic matter decomposers. Methods of application of bioagents, Quality control of bioagents, Testing of quality parameters and standardization of bioagents. Methods of evaluation of bioagents. Preparation of plan of bioagents production unit and proposal of loan, CIB Registration for bioagents, Visits to Commercial biocontrol units, KVKs and KGKs.

**Suggested readings:**


1. Alexander M. 1977. Soil Microbiology. John Wiley.
2. Bergerson FJ. 1980. Methods for Evaluating Biological Nitrogen Fixation. John Wiley and Sons.
3. Motsara, I.M.R., Bhattacharyya, P. and Srivastava, B. 1995. Biofertilizer Technology, Marketing and Usage- A Source Book-cum-glossary. FDCO, New Delhi.
4. Subba Rao, N.S. Biofertilizers in Agriculture and Forestry. 1993. Oxford and IBH. Publ. Co., New Delhi.
5. Burges, H.D. and Hussey, N.W. (1971). Microbial Control of Insects and mites. Academic Press, New York.
6. Burges, H.D. Formulation of microbial pesticides – Kluversep, ACB, Dordrecht-ISBN. 0412 625 202.
7. Coppel H.C. and J.W. Martin. (1977). Biological control of insect pest suppression. Springail.
8. De Bach P. 1964. Biological control of Insect Pest and Weeds Chapman and Hall, New York.
9. Gautam, R.D. ( 2006). Biological suppression of insect pests. Kalyani Publisher, New Delhi.
10. Huffaker, C.B. and Messenger, P.S. (1976). Theory and Practice of Biological control. Academic Press, New York.
11. Ignacimuthu, S.S. and Jayaraj, S. (2003). Biological Control of Insect Pests. Phoenix Publ. New Delhi.
12. Saxena, A.B. (2003). Biological Control of Insect Pests. Anmol Publ. New Delhi.
13. Huffaker, C.B. and Messenger, P.S. (1976). Theory and Practice of Biological control. Academic Press, New York.
14. Pepper HJ and Perlman D. 1979. Microbial Technology. 2nd Ed. Academic Press.
15. A century of Nitrogen Fixation Research Present status and Future propects. 1987. F.J. Bergersen and J.R. Postgate The Royal Soc., London.
16. Biology and Biochemistry of Nitrogen fixation. 1991. M.J. Dilworth,and A.R. Glenn, Elsevier, Amsterdam. .
17. Nitrogen Fixation in plants. 1986. R.O.D. Dixon,and C.T. Wheeler, Blackie USA, Chapman and Hall, New York.
18. A treatise on dinitrogen Fixation Section IV. Agronomy and Ecology 1977. R.W.F Hardy, and A.H. Gibson John Wiley & Sons, New York..
19. Bioresearches technology for sustainable agriculture. 1999. S. Kannaiyan, Assoc. Pub. Co., New Delhi.
20. Biofertilizer Technology, Marketing and usage- A source Book -cum-glossary 1995. Motsara, I. M.R., P. Bhattacharyya and Beena Srivastava, FDCO, New Delhi.
21. Symbiotic nitrogen fixation in plants, 1976. P.S. Nutman, Cambridge Univ. Press, London.
22. Hand book for Rhizobia; Methods in legume Rhizobium Technology, 1994. P. Somasegaran and H.J. Hoben Springer-Verlag, New York.
23. Biofertilizers in Agriculture and Forestry 1993. N.S. Subba Rao Oxford and IBH Publ. Co., New Delhi.


**Mushroom Production Technology** **2 (0 + 2)**

**Course Objectives:**

1. To make the learners self reliant to identify several kind of mushrooms.
2. To provide detailed hands on training on mushroom cultivation, packaging and marketing.

3. To develop a business plan on mushroom cultivation.
4. To help the learners to practice a means of self employment and income generation.

**Syllabus**

**The following topics are to be covered under this skill enhancement course on mushroom production technology:** History and Scope, Taxonomy and Biology, Types of Edible Mushrooms, Nutritional and Medicinal Value, Identification of Poisonous Mushrooms**,** Spawn Production: Pure Culture Techniques, Culture Media Preparation, Spawn Production Methods, Storage and Handling of Spawn**,** Storing and Transporting mushroom spawn, Composting and Substrate Preparation: Composting Methods, Substrate Materials**,** Pasteurization and Sterilization, Cultivation Practices: Mushroom House Construction, Spawning and Spawn Running, Casing Layer, Harvesting and Post-Harvest Handling, Identification and management of common diseases and pests affecting mushroom cultivation, Techniques for managing weeds in mushroom cultivation, Sanitation and Hygiene**.** Post-Harvest Technology: Preservation Methods **(**drying, freezing, and canning), Development of value-added products from mushrooms, Quality Assurance and Marketing.
Practicals: Mushroom Identification and Classification: Identification of edible vs. poisonous mushrooms, Microscopic examination of spores and mycelium, Study of different cultivated species: oyster, button, milky, paddy straw, etc. Spawn Preparation**:** Preparation of mother spawn using PDA (Potato Dextrose Agar) medium, Sub-culturing and maintenance of pure cultures, Spawn running on sterilized grain substrates, Substrate Preparation**:** Preparation of substrates using wheat straw, paddy straw, sawdust, etc., Pasteurization and sterilization methods (steam, hot water, chemical), Supplementation with nutrients (bran, gypsum, etc.), Mushroom Bed Preparation and Inoculation: Bed preparation techniques for various mushroom types, Inoculation of spawn into substrates, Incubation and spawn run observation, Cultivation and Crop Management: Maintenance of temperature, humidity, light, and air exchange, Use of cultivation chambers or polyhouses, Cleaning and sanitation practices, Pest and Disease Diagnosis: Identification of fungal, bacterial, and viral diseases, Management of common pests like mites and springtails, Disinfection protocols and hygiene maintenance, Harvesting and Post-Harvest Handling: Harvesting at appropriate growth stages, Cleaning, grading, and packaging of mushrooms, Short-term and long-term preservation: sun-drying, freezing, pickling, canning, Value-Added Products and Marketing: Preparation of mushroom pickles, powders, soups, and snacks, Branding and labeling exercises, Visit to local mushroom farms and markets, Exposure to packaging technologies and equipment.

**Suggested readings:**

1. Pandey, R.K. and Ghosh, S.K. (1996). A handbook of Mushroom Cultivation. Emkey Publication.
2. Pathak, V.N. and Yadav, N. (1998). Mushroom Production and Processing Technology. Agrobios, Jodhpur.
3. Nita, B. (2000). Handbook of Mushrooms. Vol 1 & 2. Oxford and IBH Publishing Co. Pvt. Lt.
4. Tewari, P. and Kapoor S.C. (1998). Mushroom Cultivation, Mittal Publication, New Delhi.
5. Marimuthu, T. et al. (1991). Oster Mushroom. Department of Plant Pathology. Tamil Nadu Agricultural University, Coimbatore.
6. Nita Bhal. (2000). Handbook on Mushrooms. 2nd ed. Vol. I and II. Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi.
7. Pandey R.K, S. K Ghosh, 1996. A Hand Book on Mushroom Cultivation. Emkey Publications.
8. Pathak, V. N. and Yadav, N. (1998). Mushroom Production and Processing Technology. Agrobios, Jodhpur.
9. Tewari Pankaj Kapoor, S. C. (1988). Mushroom Cultivation. Mittal Publication, New Delhi.
10. Tripathi, D.P. (2005) Mushroom Cultivation, Oxford & IBH Publishing Co. PVT.LTD, New Delhi.
11. V.N. Pathak, Nagendra Yadav and Maneesha Gaur, (2000). Mushroom Production and Processing Technology/ Vedams Ebooks Pvt Ltd., New Delhi.

**Video Production** **2(0 + 2)**

**Course Objective:**

**1.** To introduce students to the technical and creative aspects of video production.

**2.** To provide hands-on training in scripting, shooting, editing, and producing video content.
**3.** To develop storytelling and visual communication skills for broadcast and digital platforms.

**Syllabus:**

**The following topics are to be covered under this skill enhancement course on video production:** Evolution of video production: analog to digital, Types of video content: documentary, fiction, corporate, news, promotional, educational, Stages of production: pre-production, production, post-production, Idea development, research, and scripting, Storyboarding and shot breakdown, Production planning: budgeting, scheduling, crew roles, Camera types and operation: DSLR, mirrorless, ENG, cinema cameras, Shot composition, camera movements, and framing, Lighting techniques for indoor and outdoor shoots, Basics of sound recording and use of microphones, Video editing software: Adobe Premiere Pro, Final Cut Pro, DaVinci Resolve, Editing principles: continuity, rhythm, transitions, Sound editing, voice-over, dubbing, and background score, Adding titles, graphics, and color correction, Formats and codecs (MP4, MOV, AVI, etc.), Output for different platforms: TV, YouTube, OTT, social media, Legal and ethical aspects: copyright, licensing, fair use.

**Practical:** Writing and visualizing a video script, Shooting short video assignments using mobile phones or cameras, Hands-on training in editing a 1–2 minute video project, Recording interviews, vox pops, or promotional clips, Creating B-roll footage and using it effectively, Producing a complete short video as final project.

**Suggested readings:**


1. Millerson, Gerald – *Video Production Handbook*
2. Herbert Zettl – *Television Production Handbook*
3. James C. Foust – *Video Production for Mass Media*
4. Steven Ascher & Edward Pincus – *The Filmmaker's Handbook*
5. Online resources: YouTube Creator Academy, Adobe tutorials, BBC Academy


**Food Processing** **2(0+2)**

**Course Objectives:**

1. Understand the principles of food processing and preservation
2. Learn about various food processing technologies (e.g., thermal, non-thermal, dehydration)
3. Familiarize with food quality control and safety measures
4. Develop skills in designing and operating food processing systems
5. Analyze case studies and develop solutions for food processing industries

**Syllabus:**

**The following topics are to be covered under this skill enhancement course on food processing: Introduction to Food Processing** Definition, scope, and importance of food processing**,** Food processing industry overview and trends**,** Food safety and quality regulations. **Food Preservation Principles,** Food spoilage and preservation methods (e.g., heat, cold, dehydration) Food preservation technologies (e.g., canning, freezing, drying)**,** Food additives and preservatives. **Thermal Processing,** Principles of thermal processing (e.g., heat transfer, sterilization)**,** Thermal processing technologies (e.g., pasteurization, sterilization, blanching) Equipment and machinery used in thermal processing. **Non-Thermal Processing** Principles of non-thermal processing (e.g., high pressure, pulsed electric field)**, Non**-thermal processing technologies (e.g., high pressure processing, irradiation)**,** Applications and benefits of non-thermal processing. **Dehydration and Concentration,** Principles of dehydration and concentration (e.g., drying, evaporation)**,** Dehydration and concentration technologies (e.g., spray drying, freeze drying)**,** Equipment and machinery used in dehydration and concentration **Food Quality Control and Safety** Food quality control measures (e.g., HACCP, sensory evaluation), Food safety regulations and standards (e.g., FSSAI, Codex Alimentarius) Food quality and safety management systems. Cost analysis and establishment of enterprise based on this skill enhancement course.

**Practicals:**

1. Food Preservation Techniques: Practice various food preservation techniques, such as canning, freezing, and dehydration.
2. Thermal Processing: Conduct thermal processing experiments, such as pasteurization and sterilization, and evaluate their effects on food quality.
3. Non-Thermal Processing: Conduct non-thermal processing experiments, such as high pressure processing and pulsed electric field processing, and evaluate their effects on food quality.
4. Dehydration and Concentration: Practice dehydration and concentration techniques, such as spray drying and freeze drying, and evaluate their effects on food quality.
5. Food Quality Evaluation: Evaluate the quality of processed foods using various methods, such as sensory evaluation and instrumental analysis.
6. Moisture Content Determination: Determine the moisture content of food products using various methods.
7. pH and Acidity Measurement: Measure the pH and acidity of food products.
8. Texture Analysis: Analyze the texture of food products using various instruments.
9. Color Measurement: Measure the color of food products using various instruments.
10. Microbial Analysis: Conduct microbial analysis of food products to evaluate their safety and quality.

**Suggested readings:**

1. Food Processing Technology by P. Fellows
2. Food Science and Technology by G. Campbell-Platt
3. Food Processing: Principles and Applications by S. Clark
4. Food Preservation Techniques by various authors
5. Thermal Processing of Foods by various authors
6. Non-Thermal Food Processing Technologies by various authors
7. Food Quality Control and Safety by various authors

**Basic of Agriculture Startups and Entrepreneurship 2 (0 +2)**

**Course Objectives:**

1. To impart knowledge on entrepreneurship concepts in the context of agriculture.
2. To develop skills for identifying, starting, and managing agri-startups.
3. To understand government schemes, legal frameworks, and market opportunities.
4. To encourage innovation and self-employment in the agricultural sector.

**Syllabus:**

**The following topics are to be covered under this skill enhancement course on basic of agriculture start ups and entrepreneurship:** Definition, types, and characteristics of entrepreneurship, Role of entrepreneurship in economic development, Entrepreneurial mindset and motivation, Challenges in rural entrepreneurship, Concept and need of agri-startups, Agri-tech startups: precision farming, supply chains, IoT in agriculture, Business model canvas for agriculture startups, Case studies of successful agri-startups (e.g., DeHaat, Ninjacart, AgroStar), Opportunity identification and market analysis, Writing business plans for agri-enterprises, Risk management and SWOT analysis, Intellectual Property Rights (IPR) and innovations, Sources of finance: Banks, NABARD, venture capital, angel investors, Budgeting, financial statements, and break-even analysis, Registration and licensing of startups, Government schemes: PMFME, RKVY-RAFTAAR, Startup India, Agri-Clinics, Role of incubators and accelerators in agri-startups, Role of KVKs, FPOs, and Agri-Business Incubation Centers (ABI), Scaling strategies and expansion models, Role of ICT and digital platforms in scaling startups

**Practicals:**

1. Interaction with local entrepreneurs and agri-startups.
2. Preparation of business model canvas.
3. Writing a project proposal for an agri-startup.
4. Visit to an incubation center/FPO.

**Suggested readings:**

1. Taneja & Gupta – *Entrepreneurship Development*
2. S.S. Khanka – *Entrepreneurial Development*

3. Government of India – *Startup India Guidelines*
4. NABARD reports and publications
5. Online platforms: Startup India, AgriStartups.in, MANAGE portal.

**Dairy Business Management** **2(0+2)**

**Course Objectives:**

1. Understand the dairy industry's structure, trends, and challenges
2. Learn dairy farm management practices, including milk production and quality control
3. Familiarize with dairy processing, marketing, and distribution channels
4. Develop business management skills, including financial management, marketing, and human resource management
5. Analyze case studies and develop business plans for dairy enterprises

**Syllabus:**

**The following topics are to be covered under this skill enhancement course on dairy business management;** Concept of dairy business management, managerial decision making, functions of management. Planning objectives, classification of plans, planning related to finance, production and personnel aspects of the dairy. Organising-fundamentals of organizational design, departmentation, principles and delegation of authority. Responsibility and accountability. Staffing-Personnel management, planning, selection, introduction, orientation and training of unskilled and skilled personnel in dairy organizations. Project appraisal and monitoringStandards and norms for appraisal, monitoring and its tools, management information systems, net present value and internal rate of return. Demand analysis-Determinants of demand of dairy products, responsiveness of demand, estimation of product and factor demand, types and approaches for demand forecasting. Cost analysis-Application of different cost concepts and functions in managerial decisions. Pricing-determinants of price of dairy products, pricing under different objectives and market structures, product differentiation and product-mix decisions. Profit planning and Control-Concept, profit planning and break-even analysis in dairy industry, World Trade Organization (WTO). Introduction to Intellectual Property Rights. Cost analysis and establishment of enterprise based on this skill enhancement course.

**Practicals:**

1. Delineation of milk shed area.
2. Case studies for solving problem situations.
3. Demand forecasting
4. Estimation of cost of milk procurement and processing.
5. Break-even analysis and break-even charts.
6. Use of PERT in dairy industry.
7. Optimisation of product-mix.
8. Estimation of cost of inventory.
9. Economic lot size and other quantity standards.

**Suggested readings:**

1. The Dairy Industry: Structure, Conduct, and Performance by various authors
2. Dairy Business Case Studies by various authors
3. Dairy Market Analysis and Trends by various authors
4. Sustainable Dairy Farming Practices by various authors
5. Dairy Business Planning and Development by various authors
6. Dairy Business Management by R. K. Singh
7. Dairy Science and Business by P. N. Bhat
8. Dairy Management: A Practical Approach by S. K. Gupta

**Poultry Production Technology** **2 (0 + 2)**

**Course Objective:**

1. To make the students aware about poultry based livelihood system in agriculture.
2. To expose the student to various aspects of establishment and management of a poultry farm.
3. To enhance the skill for employment and entrepreneurship in poultry production.

**Syllabus**

**The following topics are to be covered under this skill enhancement course on poultry production technology:** Important Indian and foreign breeds of poultry; Breeding management of chick, grower and layer birds; Incubation and hatching, management of incubator during incubation; Care and management of chicks, grown up birds; Equipment, feeders, drinker systems, housing programs; Farm knout, house design, orientation of shed, cross ventilation, lighting systems; Floor space requirements, brooder space, water space and feeding space at different age of broilers; Random weighing of chicks; commonly used major feed ingredients identification; Feed manufacturing, preparation of feed for different age groups of broilers; Different methods of injection and procedure; Structure of poultry eggs, selection and care of hatching egg; Disease of poultry; Vaccination schedule. Bio-security Measures in Poultry Farm, Record Keeping, Entrepreneurship and Marketing.

**Practicals:**

1. External body parts of poultry birds. Identification of different breeds of poultry.
2. Handling and Identification methods of poultry.
3. Visit to poultry farms.
4. Daily routine farm operations and farm records of poultry farms.
5. Judging, selection & culling of poultry.
6. Planning and layout of housing for different types of poultry.
7. Computation and formulation of ration for poultry.
8. Study composition and nutritive composition of poultry eggs.
9. Collection, Grading, Handling and storage of eggs.
10. Hatchery management of poultry.
11. Management of chicks, growers and layers.
12. Poultry farm equipment's.
13. Debeaking, dusting of poultry.
14. Different diseases of livestock and poultry, their prevention and control.
15. Economics of poultry production.

**Suggested readings:**


1. A Textbook of Animal Husbandry by G. C Banerjee (8th Edition)
2. Livestock Production Management by N.S.R. Sastry and C.K. Thomas (2021)
3. Handbook of Animal Husbandry by ICAR (Latest)
4. Textbook of Commercial Poultry production and Hatchery Management by Dr. M. Murgan (2019)


**Piggery Production Technology** **2(0 + 2)**

**Course Objectives:**

1. Understand the principles of piggery production and management
2. Learn about pig breeding and genetics
3. Familiarize with pig nutrition and feeding systems
4. Develop skills in pig health management and disease control
5. Analyze production systems and develop strategies for improvement

**Syllabus:**

**The following topics are to be covered under this skill enhancement course on piggery production technology:** Introduction to Piggery Production Overview of the pig industry and its importance**,** Pig production systems and their characteristics**,** Breeding and genetics in pig production Breeding and Genetics Principles of pig breeding and genetics**,** Breeding objectives and selection methods**,** Genetic improvement programs for pigs**.** Pig Nutrition and Feeding Nutritional requirements of pigs**,** Feed formulation and feeding systems**,** Feed additives and growth promoters**.** Pig Health Management Principles of pig health management**,** Disease control and prevention measures**,** Vaccination and biosecurity protocols**.** Pig Production Systems**,** Intensive and extensive pig production systems**,** Housing and equipment for pig production**,** Waste management and environmental impact. Production Planning and Management**,** Production planning and record-keeping**,** Financial management and marketing strategies**,** Quality control and

assurance in pig production. Cost analysis and establishment of enterprise based on this skill enhancement course.

**Practicals:**

1. Pig Farm Visit: Visit a pig farm and observe pig production systems, including breeding, feeding, and health management.
2. Pig Breeding and Genetics: Practice pig breeding and genetics techniques, including selection and mating programs.
3. Pig Nutrition and Feeding: Formulate and prepare pig feed rations, and evaluate their nutritional content.
4. Pig Health Management: Identify and diagnose common pig diseases, and develop health management plans.
5. Pig Production System Design: Design and evaluate pig production systems, including housing and equipment.
6. Pig Feed Analysis: Analyze the nutritional content of pig feed using various laboratory techniques.
7. Pig Disease Diagnosis: Diagnose pig diseases using laboratory techniques, such as microscopy and serology.
8. Pig Production System Simulation: Use computer simulations to model and evaluate pig production systems.

**Suggested readings:**

1. Piggery Production and Management by P. K. Pathak
2. Pig Nutrition and Feeding by R. K. Singh
3. Pig Health Management by S. K. Gupta
4. Pig Production: Principles and Practices by various authors
5. Pig Breeding and Genetics by various authors
6. Pig Nutrition and Feeding Systems by various authors
7. Pig Health and Disease Management by various authors

**Value Added Milk Product Technology 2(0 + 2)**

**Course Objective:**

**1.** To develop understanding of processing techniques for value-added dairy products.
**2.** To learn formulation, quality control, and packaging of traditional and novel dairy foods.
**3.** To promote entrepreneurial and industrial applications of value-added dairy technology.

**Syllabus;**

**The following topics are to be covered under this skill enhancement course on value added milk product technology:** Scope, importance, and market potential of value-added milk products, Govt. policies for manufacture and marketing of traditional dairy products, Modern machinery, equipments, utensils required for dairy processing and its availability, Functional, probiotic, and designer dairy products, Manufacturing and packaging of khoa, paneer, chhana, rabri, gulab jamun, peda, rasgulla, basundi, etc. Quality standards and shelf-life improvement techniques, Technology of curd, yoghurt, lassi, shrikhand, kefir, kumis, and dahi, Selection of starter cultures and fermentation control, Probiotic dairy products: definition, health benefits, and safety standards, Ice cream, kulfi, frozen yoghurt, and novelties, Ingredients, mix formulation, homogenization, aging, freezing, packaging, and storage, Formulation and production of flavored milk, energy milk, fortified milk (vitamins, minerals, herbal), Health-oriented dairy drinks (high-protein milk, lactose-free milk), Shelf-stable milk-based beverages (UHT, aseptic), Concept of neutraceuticals and functional foods, Microencapsulation and value-added dairy powders, Use of enzymes and bioactive components, cost analysis of dairy processing enterprise. Preparation and composion of milk products as: Liquid, Heat desicated, Frozen, Fermented, Fat rich, Coagulated, Condance, Dried, Cereals and by products.

**Practicals:** Preparation of khoa, paneer, chhana, and regional sweets, Manufacture of dahi, lassi, probiotic yogurt. Ice cream mix standardization and preparation. Development of flavored milk and milk-based beverages. Testing sensory, microbiological, and physicochemical quality. Packaging and shelf-life evaluation. Visits to dairy processing plants or food innovation centers.

**Suggested readings:**

1. Achaya K.T. and Rangappa S.K. (1973), Indian Dairy products.
2. Aneja R.P; Mathura, B.N; Chandan R.C and Banerjce A.K. (2002) Technology of Indian Milk Product.
3. Anonymonous, (1998) Lecture Compendium Dairy Technol. NDRI, Karnal.
4. Arbuckle, W.S., (1972) Ice Cream, A,Vl publication, Westpord.
5. Aulhor, La Grange llinoisHall, C.W. and Hedrick. T.ly (1971) Drying of milk and milk products, AVI
6. Bhandari, V., (2001) Ice cream Manufacture and Technology. Tala Me Graw-Hill publishing Co,Ltd, New Delhi.
7. Cheryen, Munir, (1990), Ultrafiltration and microfiltration Hand book. Technomic Publishing House.
8. Gould G.W., (1995), Advances in traditional dairy products. publishing Co, Weeport.

**ONLINE COURSES**

The students will have to take a minimum of 10 credits of online courses (as per UGC guidelines for online courses) as a partial requirement for the B.Sc. (Hons) Agriculture.

The online courses can be from any field such as Agricultural Science, Basic Sciences, Humanities, Commerce, Business Management, Languages including foreign language, Communication skills, Music, Data Science, Computer Science etc. and can be taken from SWAYAM, Diksha, NPTEL, mooKIT, edX, Coursera, or any other portal.

The objective is to allow the students to groom their passion or strengthen their knowledge and competency in any field beyond prescribed courses. The students will take prior approval of the courses they opt from the concerned Dean/Assoc.
Dean/Principal of the Faculty/College/Institute.

The courses will be non-gradial as separate certificates would be issued by the Institute/ University offering the courses. However, the University/ institute will keep a record of such courses registered and completed by each student and will indicate the title of the (successfully completed) courses in final transcript issued to the student

**Note: List of multidicipalinery, value added, ability enhancement and non gradial courses**

| Semester | Multi- Disciplinary Course (MDC) | ValueAddedCourse (VAC) | Ability Enhancement Course (AEC) | Non- Gradial |
|---|---|---|---|---|
| I | S0148007, Farming based livelihood systems -3(2+1) | - | S0148004, Communication Skills -2(1+1) | S0148001 Deeksharambh 2(0+2) +1(14) |
| | | | S0148013 NSS-I/ S0148014 NCC-I – 1(0+1) | S0148011 Introductory mathematics / S0148012 Introductory Biology 1(1+0) |
| II | | S0248004 Environmental Studies and Disaster Management- 3(2+1) | S0248003 Personality Development 2(1+1) | - |
| | | | S0248009 NSS-II/ S0248010 NCC-II– 1(0+1) | |
| III | S0348002Entrepreneurship Development and Business Communication - 3(2+1)) | - | S0348003 Physical Education, First Aid, Yoga Practices and Meditation- 2(0+2) | - |
| IV | - | S0448002 Agricultural Informatics and Artificial Intelligence 3 (2+1) | ---- | - |
| V | S0548001 Agricultural Marketing and Trade - 3(2+1) | - | - | - |
| VI | - | - | - | S0648011 Study Tour 2(0+2) |
| Total | 9 | 6 | 8 | 5 |