



**Acharya N.G.Ranga Agricultural University
Lam, Guntur**

**ICAR SIXTH DEANS' COMMITTEE DRAFT REPORT
on
RESTRUCTURING UNDER GRADUATE
AGRICULTURAL EDUCATION PROGRAMS
TO IMPLEMENT NEP 2020 POLICY**

**Course Curricula
for
Undergraduate programme
in
Agriculture**

**NEP-NHEQF Aligned
Curriculum and Credits Framework
For Undergraduate Degree Programs
of Agricultural Science Disciplines**

ICAR

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ICAR- SIXTH DEANS COMMITTEE

Task Accomplishment Certificate

The 6th Deans Committee was set up by ICAR, on the recommendations of the ICAR Expert Committee on Implementation Strategy for executing National Education Policy across the 13 disciplines that fall under Agriculture and Allied Disciplines of Agricultural Education system. Under NEP regime, ICAR as Professional Standards Setting Body (PSSB) for Agricultural Education in the country, has the primary task of prescribing the course curricula and credit framework that will govern agricultural education in the country. Therefore, as a step towards implementing NEP, ICAR constituted 6th Deans Committee with a specific mandate of restructuring course curricula and regulations for the degree programs in operation under agricultural education in the country.

The committee members, comprising of the Chairman and Deans, representing each academic program, as expert members, held several deliberations and prepared a framework of the restructured academic system, defining credit hours, focus of semesters, integration of skill development opportunities and system of specialization within the degree programs. It will be common to all programs. Thereafter, each Member-Dean, worked with experts within their respective disciplines working across universities/institutions to restructure the course curricula as per NEP-NHEQF, that was considered paramount imperative. Draft notes were circulated among the members and academic experts for their suggestions. Committee also received inputs from ICAR, through the office of Deputy Director General - Education. Report of the 6th Deans Committee is an outcome of these efforts.

This NEP-NHEQF guided restructuring of Undergraduate Programs of agricultural Science, is expected to help build strong foundation of both knowledge and skills. More emphasis has been given to Skill training and flexibility in choice of courses to adopt the choice-based credit system. It is our belief that the restructured academic programs will help produce new generation of human resources in agricultural domain/disciplines which will be equipped to meet the needs of new knowledge and skills in agricultural sector.

The committee members draw satisfaction in accomplishing this task and are grateful to ICAR for reposing trust on them to undertake this onerous task, as well as to office of DDG Education for coordination support services during the process. We thank all those academicians across the agricultural education landscape of the country, who were consulted, who offered new ideas and those who offered constructive criticism. Down the years, we look forward to see the fruits of this work by way of transformed agricultural education system of the country.

April 20, 2024

DR TEJ PARTAP
Chairman, 6th Deans Committee, ICAR

Composition of Sixth Dean's Committee

S. No.	Name	Expert
1.	Dr Tej Pratap, Former Vice Chancellor, GBPUAT Pantnagar, SKUAST, Srinagar and CSKHPKV, Palampur	Chairman
2.	Dr Jayant Deka, Dean Faculty of Agriculture, AAU Jorhat (Assam)	Member
3	Dr S K Das , Dean College of agricultural Engineering & technology, OUAT, Bhubaneswar	Member
4.	Dr V.R. Kiresur, Professor (Agril Economics), & Head, Project Planning & Monitoring Cell UAS Dharwad, Karnataka	Member
5.	Dr Ramesh Bhat, Professor & Head, Department of Biotechnology, College of Agriculture, UAS, Dharwad , Karnataka	Member
6.	Dr Meenu Srivastava, Dean, College of Community science, MPUAT, Udaipur, Rajasthan	Member
7.	Dr RRB Singh, VC, Dau Shri Vasudev Chandrakar Kamdhenu Vishwavidyalaya, Durg, Chhatisgarh	Member
8.	Dr B.K. Das, dean of faculty of Fishery Sciences , WBUAFS Kolkata	Member
9.	Dr Rita Raghuvansi, Dean College of Community science, GBPAUT, Pantnagar	Member
10.	Dr. R.F. Sutar, Dean, Faculty of Food processing & Bio-engineering	Member
11.	Dr. K.T. Parthiban, dean (Forestry), Forestry College and research Institute, Tamil Nadu Agrl. University, Mettupalayam, Tamil Nadu	Member
12.	Dr. M.I.S. Gill, dean, college of Horticulture and Forestry, PAU, Ludhiana	Member
13.	Dr. S. Chandrasekhar, Professor and Head, department of sericulture, UAS, GKVK, Bellary road, Bangalore	Member
14.	Dr. S.K. Sharma, ADG(HRM), KAB-II, New Delhi	Member
15.	Dr. Ajit Singh Yadav, ADG(EQAR), KAB-II, New Delhi	Member Secretary

SIXTH DEANS' COMMITTEE: TERMS OF REFERENCE

1.1 Constitution of Committee for drafting the Implementation Strategy for Higher Agriculture Education

As a follow up to the National Education Policy-2020 (NEP 2020), ICAR, as Professional Standards Setting Body (BSSB) of agricultural education for the NEP-2020, set up a high-level committee comprising of the Vice Chancellors of Agriculture Universities. It was asked to devise a strategy for implementing NEP-2020 in agricultural education. Besides several other recommendations, the high-level committee recommended the constitution of 6th Deans' Committee for restructuring the course curricula, framed by the 5th Deans Committee. Universities have adopted the 5th Deans Committee for implementation during the past few years. The NEP-2020 required that this course curriculum is restructured to fit into the new academic regime.

1.2 Notification for Setting up the Sixth Deans' Committee

On the Recommendations of ICAR-NEP Implementation Strategy Committee, ICAR constituted the 6th Deans' Committee on August 17, 2021 (orders issued on Sep 15, 2021) vide notification *F. No. Edn.5/24/202/EQR/VI Deans*. The 6th Deans' Committee was mandated to restructure the existing course curricula so as to enable implementation of NEP 2020 in agricultural education.

1.3 Terms of References of the 6th Deans' Committee

- i) **Restructuring of all UG Programs**, All UG programs to be restructured as per NEP 2020 and NHEQF.
- ii) **Structure of first year UG Certificate Course**, areas, end of course test and criteria for entry into second year Diploma course as per provisions of NEP 2020
- iii) **Admission Criteria for UG-Certificate and UG Diploma courses**, in view of the multiple entry and exit system provision under NEP.
- iv) **Guidelines for Entrepreneurship** of students
- v) **Guidelines on provision for increasing gross enrolment ratio (GER)**, progressively.
- vi) **Defining UG and PG degrees** for general market needs, as well as for specialist jobs and **uniformity in UG and PG degree nomenclature**.
- vii) Any other point related to NEP-2020.

Chapter 2

PROLOGUE

2.1 Aim of Restructuring Agricultural Education

Education is at the heart of both personal and community development; its mission is to enable each of us, without exception, to develop all our talents to the full and to realize our creative potential, including responsibility for our own lives and achievement of our personal aim. There is therefore every reason to place renewed emphasis on the moral and cultural dimensions, apart from what is taught presently, enabling each person to grasp the individuality of other people and to understand the world's progression towards an uncertain future.

The 21st century is showing all signs of providing unprecedented means for communication and for the circulation and storage of information. Therefore, it will impose on education two demands which at first sight may appear contradictory. Education must transmit, efficiently and on a massive scale, an increasing amount of constantly evolving knowledge and know-how adapted to a knowledge driven civilization, because this forms the basis of the skills of the future. At the same time, it must find and mark the reference points that will make it possible, on the one hand, for people not to be overwhelmed by the flows of information, invading the public and private domains and, on the other, to keep the development of individuals and communities as its end in view. Education must, as it were, simultaneously provide maps of a complex world in constant turmoil and the compass that will enable people to find their way in it.

In this view of the future, traditional responses to the demand for education that are essentially quantitatively, and knowledge based are no longer appropriate. It is not enough to supply each student with a store of knowledge to be drawn on from then on. Instead, everyone must be equipped to seize learning opportunities throughout life, both to broaden her or his knowledge, skills, and attitudes, and to adapt to a changing, complex and interdependent world.

2.2 Four Pillars of Education

The International Commission on Education in its report "Learning: The Treasure Within" (UNESCO, 1996) has defined "why and how" agenda for modifying education for 21st century, globally. It advocated inclusion of the concept of following four pillars of education if education is to succeed in its task. NEP also has advocated similar perspective of future education system in India. Sixth Deans' Committee would like to lay stress on institutions to reorganize their existing academic system of agricultural education around these four fundamental types of learning. In a way these pillars must remain the pillars of knowledge, throughout a person's life.

1. *Learning to know*, that is acquiring the instruments of understanding.
2. *Learning to do*, to be able to act creatively on one's environment.
3. *Learning to live together*, so as to participate and cooperate in all human activities.
4. *Learning to be* an essential progression which proceeds from the previous three.

These four paths of knowledge, all form a whole with many points of contact, intersection, and exchange among them.

2.3 Constitution of the report

The report is in two parts; PART-I comprises of General Report on curriculum and credits as well as other general guidelines on admissions, evaluations, etc. that is applicable to all

disciplines, colleges, universities, institutions, who are involved in imparting higher agricultural education in any of the following ways in the country.

PART -II of the report comprises discipline wise recommendations, on restructured course curricula of undergraduate degree programs, for 13 ICAR approved disciplines.

Chapter 3

HIGHLIGHTS and NEW INITIATIVES

As per the NEP 2020 recommendations, the Sixth Deans' Committee has incorporated several new initiatives in the proposed restructured UG curricula.

3.1 Classification of level of courses with targeted outcomes

- The 1st year of the UG programme (*NHEQF Level 4. 5*) includes the Foundation courses, introductory courses and skills enhancement training/ training in the chosen area, ability enhancement courses. It is aimed that the student will acquire the basic knowledge in respective disciplines and adequate skill in some selected areas, to enable him for employment/ entrepreneurship.
- The 2nd year (*NHEQF Level 5*) includes the basic core courses and additional skill enhancement in chosen areas/ courses. It is aimed that the student will acquire the higher level knowledge in respective disciplines and adequate skill in some selected areas, to enable him for employment at middle level/ supervisory level or for entrepreneurship.
- The 3rd year includes the advanced core subjects and their practical applications with an objective that the student will have deeper understanding of the subjects and their major application areas
- The 4th year (*NHEQF Level 6*) will have the specialization/ elective courses and advanced skill enhancement through project and internship. The student 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.

3.2 Multiple Entry and Exit

There is provision of multiple entry and exit at different levels. The student has the option to exit after the 1st year. He has to complete 10 weeks of internship (10 credits) after 1st year to be eligible for award of UG-Certificate. The student has another option to exit after the 2nd year. The student has to complete another 10 weeks of internship (10 credits) after 2nd year to be eligible for award of UG-Diploma.

After four years of study, the student will be awarded UG degree in concerned discipline. No 3rd year exit is recommended considering the professional nature of the courses.

The lateral entry at 3rd semester will be for the candidates having UG-certificate or those who have completed Diploma (3 years course after 10th) in polytechnics. The lateral entry in 5th semester will be for candidates who have completed UG-Diploma.

3.3 New courses for acquiring advanced knowledge and skill and for strengthening their cultural and ethical values through choice based programmes

3.3.1 Deeksharambh (Introduction--cum foundation course)

A course entitled "*Deeksharambh*" (0+2) (Non-gradual) will be offered at the start of first semester for two weeks' duration. This will create a platform for students to learn from each

other's life experiences, help for cultural Integration of students from different backgrounds, know about the operational framework of academic process in university, instilling life and social skills, social Awareness, ethics and values, team work, leadership, creativity, etc.. It will also help in identifying 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 & research managers.

3.3.2 Common courses

The following common courses have been proposed to be offered across the disciplines. This will enable the student for better communication skills and personality development as well as to have a broader view of agriculture and allied sectors, which will allow them for future collaboration with other sectors 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

In addition to the “Deekshyarambh”, the courses as Physical Education, First Aid, and Yoga Practices, NCC and NSS have also been made compulsory for students for better social awareness and health of the future generation.

3.3.3 New age courses

New age courses like artificial intelligence, robotics, machine learning, etc. have been incorporated into the course curricula. Besides an array of elective courses have been included so that the student can get deeper knowledge and understanding in the subject of his interest. Due emphasis has been given to include the latest topics and subjects in both core and elective courses. Practical exercises and teaching methodology are proposed to make the young generation more imaginative, innovative, ingenious, creative and competent.

3.3.4 Online courses

The students will have to take a minimum of 10 credits of online courses, which will comprise of one or more courses, as a partial requirement for the UG programme. The online courses can be from any field such as Basic Sciences, Humanities, Psychology, Anthropology, Economics, Engineering, Business Management, Languages including foreign language, Communication skills/ Music, etc. and can be taken from any online portal. The objective is to allow the students to groom their passion or strengthen their knowledge and competency in any field beyond prescribed courses.

3.3.5 Elective courses

The institutions will offer a basket of Elective courses to be offered to the students. The students will 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 will also have the liberty to develop new Elective courses as per local needs and available expertise.

3.4 Imparting Traditional Knowledge, Values and Ethics

Due emphasis has been given for imbibing the traditional knowledge, values and ethics among the students through different courses like the *Deeksharambh*, NCC/ NSS/ NSO. 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.

3.5 Entrepreneurship development as a career path

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

Skill enhancement courses are included in different modes as follows.

- Skill enhancement courses in the 1st year and 2nd year as part of the course programmes
- Internship for exit programs after 1st year/ 2nd year
- Advanced skill enhancement through Student READY programmes such as in-plant training/ internship/ projects in 4th year

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

3.5.1 Skill Enhancement Courses

Skill enhancement programmes are essential requirements for any programme (UG-Certificate/ UG-Diploma or Degree). Skill enhancement programmes will be choice based; student can choose the areas of skill enhancement from a basket 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 programmes.

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, may also be offered.

3.5.2 Internship

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 strengthen skills 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.

3.5.3 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 appropriate career in research or employment/ entrepreneurship, discover his/ her interests, aptitudes and potentialities and maximise his/ her potentialities and self-confidence. It will also add to creativity and critical thinking of the students.

3.6 Introduction of new degree programmes

Two new degree programmes have been proposed in this report in two important areas.

1. Considering the natural strength of the country and future opportunities, a new UG course on 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.
2. A new degree programme on Agri-Business Management has been included. These students are expected to acquire competency and confidence to start their own enterprise, as well as will have adequate competency for getting jobs.

3.7 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 have been kept at 167 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.

3.8 Progressive evaluation

In the course programme, 20% has been kept for progressive assessment of the student within the semester in form of quizzes/ group assignments. The assessment 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 considered in form of group assignments (which should encourage creativity, critical thinking and problem solving attitude).

3.9 Academic Bank of Credit

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

3.10 Migration of students from one institution to other

It has been proposed for inter-institutional transfer of students with accumulation of the ABC. The HAEI may admit students either by holding its own admission test or use merit as criteria or by following any of the existing norms of the University. It is recommended to make institutional migration after 4th semester more convenient. HAEIs are at liberty to put in place rules/ regulations relaxing/ modifying existing provisions of migration, providing more freedom and ease to students.

3.11 Minimum requirement for establishing colleges for agriculture and allied disciplines

The minimum requirements for establishing colleges for 13 agriculture and allied disciplines have been included in this report.

3.12 Making implementation of the recommendations of the Deans' Committee mandatory

A lot of efforts have been made to improve the quality of agricultural education to make it internationally competitive. Implementation of the recommendations of the Sixth Deans' Committee to be made mandatory for accreditation of academic programmes and academic institutions by the National Agricultural Education Accreditation Board (NAEAB).

Chapter 4

RESTRUCTURING OF UNDERGRADUATE PROGRAMMES

4.1 Restructuring of UG Programs

The restructuring has been done based on the following NHEQF levels.

- Year 1, Certificate Course, NEP-NHEQF Level 4.5
- Year-2, Diploma Course, NEP-NHEQF Level 5.0
- Year 4, B.Sc. (Hons.)/ B. F.Sc.(Hons.)/ B. Tech. NEP-NHEQF Level 6.0

The restructured program for the undergraduate agriculture education with multiple entry and exit options is illustrated in Figure 4.1.

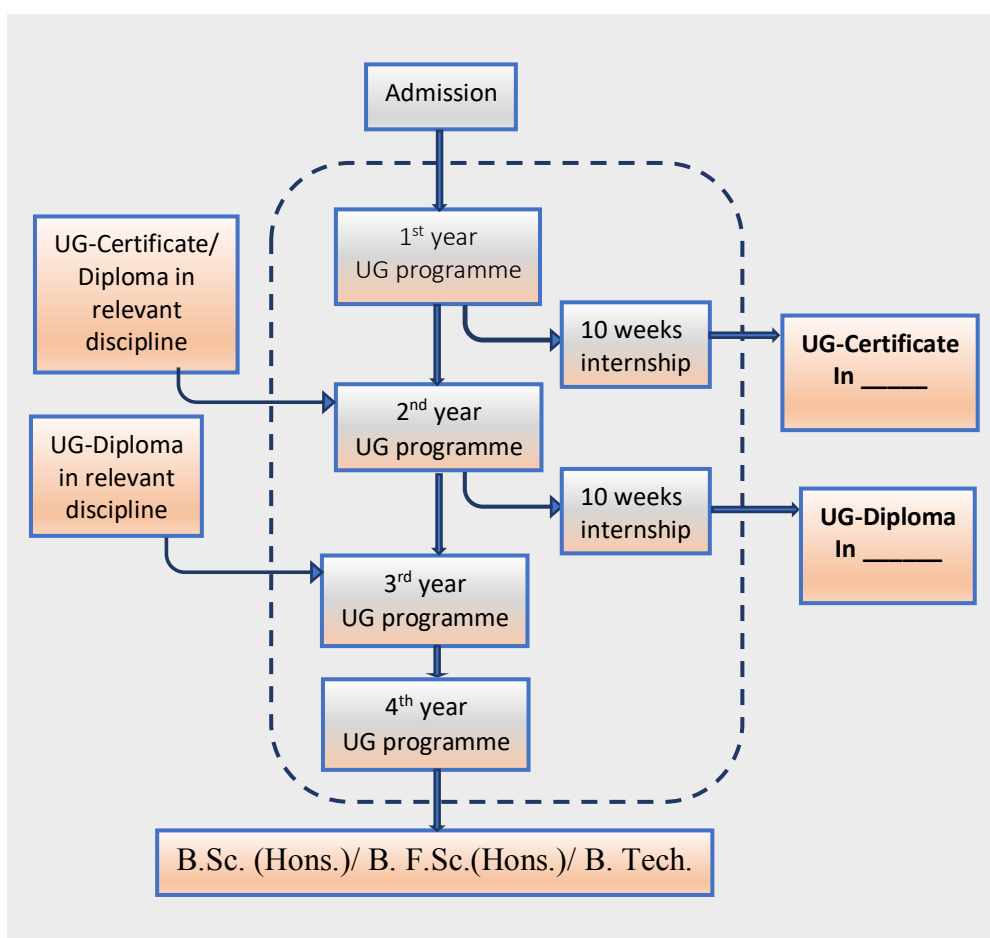


Fig. 4.1 Framework of Undergraduate Programmes

The eligibility for entry into the UG programmes will be + 2 Science; the students will be admitted as per norms of ICAR/ SAUs. The 1st year of the programme will be having the foundation, introductory and skill enhancement 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 specialisation and elective courses as well as advanced skill enhancement through internship and research.

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 and 2nd year, respectively.

Table 4.1 shows the restructured undergraduate programs for the higher agricultural educational institutions (HAEIs), as follows.

Table 4.1 Types of the courses and learning outcomes for the restructured undergraduate programs for the HAEIs

Year	Types of courses	Learning outcome	Exit option
YEAR 1 <i>NHEQF Level 4.5</i>	Foundation courses, introductory courses and skills enhancement training/ training in the chosen area, ability enhancement courses	The student will acquire the basic knowledge in respective disciplines and adequate skill in some selected areas, to enable him for employment/15student15neurs hip.	The student must complete 10 weeks of internship (10 credits) after 1 st year if exit with UG-Certificate is opted.
YEAR-2 <i>NHEQF Level 5</i>	Basic core courses and additional skill enhancement in chosen areas/ courses	The student will acquire the higher level knowledge in respective disciplines and adequate skill in some selected areas, to enable him for employment at middle level/ supervisory level or for entrepreneurship	The student must complete 10 weeks of internship (10 credits) after 2 nd year if exit with UG-Diploma is opted.
YEAR-3	Advanced core subjects and their practical applications	The student will have deeper understanding of the subjects and their major application areas	No exit after 3 rd year
YEAR-4 <i>NHEQF Level 6</i>	Specialization/ Elective courses and advanced skill enhancement through project and internship	The15studentt 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

4.2 Credit Hours Allocation

A total of **166-174** credit hours is recommended for the four years of UG programmes. The credit distributions for the different courses have been specified for individual disciplines and in disciplines like Agricultural Engineering and Food Technology, total number of credits and distribution of courses is slightly different due to the discipline related requirement. The general structure is given in Table 4.2.

Table 4.2 General Credits Allocation Scheme of UG Programs

Sem-ester	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-Gradual	Online Courses/ MOOC
I	12	3 ⁽²⁾		1 ⁽³⁾ + 2 ⁽⁴⁾	4	-	22	2 ⁽¹⁾	10
II	10	3 ⁽⁵⁾	3 ⁽⁶⁾	1 ⁽³⁾ + 2 ⁽⁷⁾	4	-	23	-	
Post-II semester						10 ⁽¹²⁾			
III	16	----		2 ⁽⁸⁾	2	-	20		
IV	12	3 ⁽⁹⁾	3 ⁽¹⁰⁾	----	2	-	20	-	
Post-IV semester						10 ⁽¹³⁾			
V	21	-	-	-	-	-	21	2 ⁽¹¹⁾	
VI	21	-	-	-	-	-	21	-	
VII	20	-	-	-	-	-	20	-	
VIII	-	-	-	-	-	20	20	-	
Total	112	9	6	8	12	20	167	4	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 Business Management

⁽⁶⁾ Environmental Studies and Disaster Management;

⁽⁷⁾ Personality Development; ⁽⁸⁾ Physical Education, First Aid and Yoga Practices

⁽⁹⁾ Agriculture Marketing & Trade; ⁽¹⁰⁾ Agriculture Informatics; ⁽¹¹⁾ Study tour (10-14 days).

⁽¹²⁾ Only for those opting for an exit with UG-Certificate ⁽¹³⁾ Only for those opting for an exit with UG-Diploma

One multidisciplinary course in Argil Eng. discipline is different from the above common courses keeping in view the discipline specific requirement for a particular course.

Note:

- The credit hours mentioned in the table includes both theory and practical.
- The maximum credit allocation and the allocation for different types of courses for some disciplines such as Agricultural Engineering, Dairy Technology and Food Technology are different than those mentioned in the Table 4.2, so as to accommodate the specific need of those disciplines.
- Also, some minor deviations in the courses and credits 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 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.) with research may lead to deficiency of the knowledge and learning of the elective / specialized subjects needed for PG studies. For B. Tech. programmes, the framework prescribed by AICTE/ UGC may be applicable. Under such circumstances, the Committee recommends that the launching UG degree with research should be deferred for the time being. ICAR may consider about this aspect along with considering restructuring PG/ Ph.D. programmes. Also considering the professional nature of the courses, 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.
- If the student has to take up any deficiency course(s), that has to be satisfactorily completed within the first year.

4.3 Deeksharambh (Introduction- cum-foundation course)

The goal of higher education is to nurture students by unfolding their hidden potentials to pursue the academic and professional studies in a diligent, honest and responsible manner by facilitating 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-gradual) will be offered at the start of first semester for two weeks' duration. 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 him/her with the new surroundings, develop bond with fellow students and teachers. It is the time when a student should become clear as to why he/she is going to study a particular discipline, or even it is time to quit and join another discipline of his/ her choice. They must develop sensitivity towards various issues of social relevance and imbibe human values to become responsible citizens.

Thus, ensuring a well-designed Induction cum foundation program by the institutions should 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, Lectures by Eminent People.
- **Associating:** visits to university / college, visits to Dept./Branch/ Program of study & 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 different backgrounds,
- Know about the operational framework of academic process in university
- Instilling life and social skills,
- Social Awareness, Ethics and Values, Team Work, Leadership, Creativity, etc.
- Identify 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 & research managers

Steps will be taken by the institutions to identify the strength and weakness of students (with remedial measures) and diverse potentialities and to enhance cultural Integration of students from different backgrounds.

4.4 Common courses

The following common courses have been proposed to be offered across the disciplines, which in addition to giving the students a broader view of agriculture and allied sectors, will enable them for better communication skills and personality development. Besides, this will also help them to look beyond the boundaries of their own subject/ discipline, which will help them for future collaboration with other sectors 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

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

4.5 New age courses

Courses like artificial intelligence, robotics, machine learning, etc. have been incorporated into the course curricula. Besides an array of elective courses have been included so that the student can get deeper knowledge and understanding in the subject of his interest. Emphasis has also been given to include the latest topics and subjects in both core and elective courses. Practical exercises and pedagogy are proposed to make the next generation more imaginative, innovative, ingenious, creative and competent.

4.6 Deficiency courses

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

4.7 Entrepreneurship development

Entrepreneurship is a key driver of the economy of a nation, which has been encouraged through NEP. Expectation is that an early orientation of the young minds towards skill enhancement and entrepreneurship will inculcate entrepreneurial mindset, allowing them to have first-hand experience of working with institutions, organizations, companies, industrial setup and investors so as 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, the curricula in all the disciplines of Agricultural education have been refined and fine-tuned with intensive focus on choice-based skill enhancement programs.

Skill enhancement courses are included in different modes as follows.

- Skill enhancement courses in the 1st year and 2nd year as part of the course programmes
- Internship for exit programs after 1st year/ 2nd year
- Advanced skill enhancement through Student READY and/or in-plant training/ internship 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 formal classroom 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 acquired must make them proactive, pioneering, prospect oriented during their internship or industrial attachment to serve as apprentices in the relevant field and will empower them to grasp viable avenues of self-employment and entrepreneurship along with diversified career options in different facets of related domains.

4.7.1 Skill Enhancement Courses

The skill enhancement programmes will be choice based; student can choose the areas of skill enhancement from a basket of skill enhancement modules offered by the parent institution. The institutions will develop capabilities for offering such courses. Universities/HAEIs can also offer UGC skill courses as per resources /expertise available . The list of these courses is given in Chapter-7.

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 programmes.

In the report, for each discipline the list of Skill Enhancement Courses (SEC) have 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 in Chapter 7 may also be offered.

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

4.7.2 Internship

The internship proposed under NEP 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 Agricultural Work Experience (RAWEx), In-Plant Training/ Industrial Attachment and Students' Projects. Therefore, in the recommended structure, the student READY is further strengthened as per NEP 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 strengthen skills 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 programmes. The coordinator must plan/execute/ monitor internship programme implementation at the institution level.

4.7.3 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 appropriate career in research or employment/ entrepreneurship, discover his/ her interests, aptitudes and potentialities and maximise his/ her potentialities and self-confidence. It will also add 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.

4.8 Study tour

There will be a study tour of 10-14 days' duration during the 5th 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 to exposing the students to the indigenous as well as the latest technologies in their related fields, will also help the students to know about the socio-economic-cultural variations within the country. The course will be of 0+2 credits, non-gradual.

4.9 Online courses

The students will have to take a minimum of 10 credits of online courses, which will comprise of 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 4-12 weeks' 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, SWAYAM 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 courses will be non-gradual as separate certificates would be issued by institutes offering the courses. These can be taken any time during the duration of UG program, but preferably during the 3rd and 4th years.

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.

The requirement of credits for online courses for B. Tech. programmes has been different due to the specific need of the disciplines.

4.10 Elective courses

The institutions will offer a basket of Elective courses to be offered to the students. The students will 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 will also have the liberty to develop new Elective courses as per local needs and available expertise. The elective courses can be offered from other disciplines in a Universality/HAls.

4.11 Imparting Traditional Knowledge, Values and Ethics

Due emphasis has been given for imbibing the traditional knowledge, values and ethics among the students through different courses like the *Deeksharambh*, NCC/ NSS/ NSO. 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.

4.12 Introduction of new degree programmes

Two new degree programmes have been proposed in this report in two important areas.

Considering the natural strength of the country and future opportunities, a new UG course on 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.

A new degree programme on Agri-Business Management has been included. These students are expected to acquire competency and confidence to start their own enterprise, as well as will have adequate competency for getting jobs.

4.13 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 have been kept at 167 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.

4.14 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 recommended the 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 shall be 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 two)
- G. In case the skill enhancement/ internship programs are conducted in collaboration with industry/ other organizations/ agencies, the students may be expected to remain out of the campus for a certain period within the semester. In that situation, the timetable should be so adjusted for the remaining part of the net instruction days (NIDs) of the corresponding semester, that each credit has at least 15 contact hours.

4.15 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.

4.16 Admission Criteria

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

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

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 who have completed Diploma (3 years course after 10th) in polytechnics. The lateral entry in 5th semester will be for candidates who have completed UG-Diploma.

There cannot be guaranteed promotion to next level. Institutions are at liberty to make their own decisions on the matter of seats and admissions in 3rd and 5th semesters.

4.17 Provision of lateral entry for Diploma holders from polytechnics

Candidates having a Diploma from polytechnics (after completion of 3 years course after 10th in related disciplines) will be entitled to take admission in the 2nd year (3rd semester) program. The HAEI may admit students either by holding its own admission test or use merit as criteria or by following any of the existing norms of the University.

4.18 Migration from one University to other

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

It is recommended to make institutional migration after 4th semester more convenient. HAEIs are at liberty to put in place rules/ regulations relaxing/ modifying existing provisions of migration, providing more freedom and ease to students.

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.

4.19 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 this stage.)

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-Certificate degree. (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.)/ B.F.Sc. (Hons.)/ B. Tech. degree

4.20 Maximum residential period

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

Students may be permitted to take a break from the study during the period of study after completion on one year of the UG programme, but the total duration for completing the UG programme shall not exceed 7 years.

4.21 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 4.3 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	40%	30%	20%	10%
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. Paper evaluation to be done by a faculty other than the course instructor(s).

Internal practical examination to be conducted by the course instructor and one faculty nominated by the HOD of the concerned department.

As mentioned earlier, 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 in any one quiz can opt for appearing for a third quiz to improve their grades. The assessment 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 considered 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 format of evaluation may be developed by the parent institute.

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

When students take deficiency course(s), they will be assessed as 'Satisfactory' or 'Unsatisfactory' 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.

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

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

$$CGPA = \frac{\sum (Grade\ point \times credit\ hours)_{until\ last\ semester}}{Total\ credit\ hours\ until\ last\ semester}$$

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 be named as overall grade point average (OGPA), which will be mentioned in the final transcript of the students.

4.22 Award of Divisions

The award of the divisions will be as follows.

Table 4.4 Award of the divisions

OGPA	Division
5.000-5.999	Pass
6.0000-6.999	II division
7.000—7.999	I Division
8.000 and above	1 st division and distinction

4.23 Uniformity in Nomenclature of Degrees

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

a. UG-Certificate with mention of discipline

e.g. UG-Certificate in Agriculture, UG-Certificate in Horticulture, UG-Certificate in Agricultural Engineering

Note: If any institution is at present offering any certificate course of less than a year period, it may continue to do so, but this certificate course will not be considered equal to UG-Certificate.

b. UG-Diploma with mention of discipline

e.g. UG-Diploma in Agriculture, UG-Diploma in Horticulture, UG-Diploma in Agricultural Engineering

Note: If any institution is at present offering any Diploma course of less than two years' period after +2 Science, it may continue to do so, but this diploma course will not be considered equal to UG-Diploma.

The nomenclature of undergraduate degrees will be per the recommendations of the 5th Deans' Committee as follows.

B. Sc. (Hons.)/ B.F.Sc. (Hons.)/ B. Tech. followed by discipline

e.g. B.Sc.(Hons.) Agriculture/ B.F.Sc (Hons.)/ B. Tech. (Agricultural Engineering)

The nomenclature of degrees may change in case any such revision is suggested by the UGC.

4.24 Increasing Gross Enrolment Ratio (GER)

Keeping in view the NEP call for increasing GER, it is recommended that provision is made by institutions to launch stand-alone UG-Certificate and/ or UG-Diploma courses in specific subjects/ disciplines. The entrance examinations for such programs will be separate. The students completing the UG-Certificate will have to appear separate entrance test for continuing to higher level. Similarly, the students completing the UG-Diploma will have to appear separate entrance test for continuing to higher level.

4.25 Academic Bank of Credits (ABC)

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

4.26 Minimum requirement for establishing colleges for agriculture and allied disciplines

The minimum requirements for establishing colleges for 13 agricultures and allied disciplines, as follows, have been included in this report.

- Agriculture
- Horticulture
- Forestry
- Fisheries
- Agricultural Engineering
- Community Science
- Food Nutrition and Dietetics
- Food Technology
- Sericulture
- Biotechnology
- Dairy Technology
- Agribusiness Management
- Natural Farming

4.27 Making implementation of the recommendations of the Deans' Committee mandatory

A lot of efforts have been made to improve the quality of agricultural education to make it internationally competitive. Implementation of the recommendations of the Sixth Deans' Committee to be made mandatory for accreditation of academic programmes and academic institutions by the National Agricultural Education Accreditation Board (NAEAB).

Chapter 5 COMMON COURSES

Deeksharambh (Induction-cum-Foundation Programme) 0+2(NG)

Objective

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

Activities

The details of activities/ schedules will be decided by the parent universities. The structure shall include, but not restricted to:

- i. Discussions on operational framework of academic process in university, as well as interactions with academic & research managers of the University
- ii. Creating awareness on the subject of study, and the traditional values and indigenous cultures along with diverse potentialities both in indigenous and developed scenario
- iii. Interaction with alumni, business leaders, perspective employers, outstanding achievers in related fields, and people with inspiring life experiences
- iv. Group activities to identify the strength and weakness of students (with expert advice for their improvement) as well as to create a platform for students to learn from each other's life experiences
- v. Field visits to related fields/ establishments
- vi. Sessions on personality development (instilling life and social skills, social awareness, ethics and values, team work, leadership, etc.) and communication skills

Farming based Livelihood Systems

3 (2+1)

Objective

- i) To make the students aware about farming based livelihood systems in agriculture
- ii) To disseminate the knowledge and skill how farming based systems can be a source of livelihood

Theory

Status of agriculture in India and different states, Income of farmers and rural people in India, Livelihood-Definition, concept and livelihood pattern in urban & 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 & 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 & success factors in farming based livelihood systems, Schemes & programmes by Central & State Government, Public & Private organizations involved in promotion of farming based livelihood opportunities. Role of farming based livelihood enterprises in 21st Century in view of circular economy, green economy, climate change, digitalization & changing life style.

Practical

Survey of farming systems and agricultural based livelihood enterprises, Study of components of important farming based livelihood models/ systems in different agro-climatic zones, Study of production and profitability of crop based, livestock based, processing based and integrated farming based livelihood models, Field visit of innovative farming system models. Visit of agri-based enterprises & their functional aspects for integration of production, processing & 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 & profit analysis, Case study of Start-Ups in agri-sectors.

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Entrepreneurship Development and Business Management

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 business unit.
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, importance of 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. Financial 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

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Agriculture Marketing and Trade

3(2+1)

Objective

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 agri commodities: nature and determinants of demand and supply of farm products, producer's surplus – meaning and its types, marketable and marketed surplus, factors affecting marketable surplus of agri-commodities; pricing and promotion strategies: pricing considerations and approaches – cost based and competition based pricing; market promotion – advertising, personal selling, sales promotion and publicity – meaning, merits and demerits; marketing process and functions: Marketing process concentration, dispersion and equalization; exchange functions – buying and selling; physical functions – storage, transport and processing; facilitating functions – packaging, branding, grading, quality control and labelling (Agmark); Market functionaries and marketing channels: Types and importance of agencies involved in agricultural marketing; meaning and definition of marketing channel; number of channel levels; marketing channels for different farm products; Integration, efficiency, costs and price spread: Meaning, definition and types of market integration; marketing efficiency; marketing costs, margins and price spread; factors affecting cost of marketing; reasons for higher marketing costs of farm commodities; ways of reducing marketing costs; Role of Govt. in agricultural marketing: Public sector institutions- CWC, SWC, FCI, CACP & DMI – their objectives and functions; cooperative marketing in India; Risk in marketing: Types of risk in marketing; speculation & 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 international trade 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.

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 IBH Publishing 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-Hall of India Private Ltd., New Delhi.
5. Kotler and Armstrong, 2005, Principles of Marketing, Pearson Prentice-Hall.
6. Lekhi, R. K. and Jogindr 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, International Book Distributing Co. Ltd, New Delhi.
9. Sharma, R., 2005, Export Management, Laxmi Narain Agarwal, Agra.

Agricultural Informatics & Artificial Intelligence (AI) 3(2+1)

Objective

- i) To acquaint students with the basics of computer applications in agriculture, multimedia, database management, application of mobile app and decision- making processes, etc.
- i) To provide basic knowledge of computer with applications in Agriculture.
- iii) To make the students familiar with Agricultural-Informatics, its components and applications in agriculture and Artificial intelligence

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 database, Uses of DBMS in Agriculture, Internet and World Wide Web (WWW): Concepts and components.

Computer programming: General concepts, Introduction to Visual Basic, Java, Fortran, C/ C++, etc. 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 analysis and crop simulation models, concepts, structure, 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, postharvest 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. Control strategies, 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 & folders, File Management. Use of MS-WORD and MS Power-point for creating, editing and presenting a scientific documents, MS- EXCEL - Creating a spreadsheet, Use of statistical tools, Writing expressions, Creating graphs, Analysis of scientific data, Handling macros. 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 smart phones and other devices in agro-advisory and dissemination of market information, Introduction of Geospatial Technology, Hands on practice on preparation of Decision Support System, Preparation of contingent crop planning, India Digital Ecosystem of Agriculture (IDEA)

Suggested Readings

1. Fundamentals of Computer by V. Rajaroman.
2. Introduction to Information Technology by Pearson.
3. Introduction to Database Management System by C. J. Date.
4. Concepts and Techniques of Programming in C by Dhabal Prasad Sethi and Manoranjan, Wiley India.
5. Introductory Agri Informatics by Mahapatra, Subrat K et al, Jain Brothers Publication.
6. Russell, Stuart, Artificial Intelligence: A Modern Approach, Pearson Edition 2013
7. Nilson N.J. 2001. Principles of Artificial Intelligence. Narosa.

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 Made Disasters - Nuclear disasters, chemical disasters, biological disasters, building fire, coal fire, forest fire, oil fire, road accidents, rail accidents, air accidents, sea accidents. International and National strategy for disaster reduction. Concept of disaster management, national disaster management framework; financial arrangements; role of NGOs, community-based organizations and media in disaster management. Central, state, district and local administration in disaster control; Armed forces in disaster response; Police and other organizations in disaster management.

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. 36 pp.
3. Erach Bharucha, Text book for Environmental studies. University Grants Commission, New Delhi
4. Parthiban, K.T. Vennila, S. Prasanthrajan, M. Umesh Kanna, S. 2023. Forest, Environment, Biodiversity and Sustainable development. Narendra Publishing House, New Delhi
5. Prasanthrajan M, P.P. Mahendran., 2008. A text book on Ecology and Environmental Science. ISBN 81-8321-104-6. Agrotech Publishing Academy, Udaipur
6. Sharma, P.D. 2009, Ecology and Environment, Rastogi Publications, Meerat, India
7. Tyler Miller and Scot Spoolman. 2009. Living in the Environment (Concepts, Connections, and Solutions). Brooks/cole, Cengage learning publication, Belmont, USA

Communication Skills

2(1+1)

Objective

To acquire competence in oral, written and non-verbal communication, develop strong personal 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 verbals; phrases and clauses; Case: subjective case, possessive case; objective case; Correct usage of nouns, pronouns and antecedents, adjectives, adverbs and articles; Agreement of verb with the subject: tense, mood, voice; Writing effective sentences; Basic sentence faults;

Practical

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

Suggested readings

1. Allport, G W, 1937, Personality: A Psychological Interpretation. Holt, New York.
2. Brown Michele & 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

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, Models of individual behavior, Perception and attributes and factors affecting perception, Attribution theory and case studies on Perception and Attribution. Learning: Meaning and definition, theories and principles of learning, Learning and organizational behavior, Learning and training, learning feedback. Attitude and values, Intelligence- types of Intelligence, theories of intelligence, measurements of intelligence, factors influencing intelligence, intelligence and Organizational behavior, emotional intelligence. Motivation- theories and principles, Teamwork and group dynamics.

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: Wadsworth

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

Objective

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 and increase stamina and general wellbeing through yoga.

Practical

Physical education; Training and Coaching - Meaning & Concept; Methods of Training; aerobic and aerobic exercises; Calisthenics, weight training, circuit training, interval training, Fartlek training; Effects of Exercise on Muscular, Respiratory, Circulatory & 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 & its Management; Posture; Postural Deformities; Exercises for good posture.

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

- Asanas (Definition and Importance) Padmasan, Gaumukhasan, Bhadrasan, Vajrasan, Shashankasan, Pashchimotasan, Ushtrasan, Tadasan, Padhastasan, Ardhchandrasan, Bhujangasan, Utanpadasan, Sarvangasan, Parvatasana, Patangasan, Shishupalanasana – left leg-right leg, Pavanmuktasan, Halasan, Sarpasan, Ardhdhanurasan, Sawasan
- Suryanamskar Pranayama (Definition and Importance) Omkar, Suryabhedan, Chandrabhedan, AnulomVilom, Shitali, Shitkari, Bhastrika, Bhramari
- Meditation(Definition and Importance), Yogic Kriyas (Kapalbhati), Tratak, Jalneti and Tribandh
- Mudras (Definition and Importance) Gyanmudra, Dhyamudra, Vayumudra, Akashmudra, Pruthvimudra, Shunyamudra, Suryamudra, Varunmudra, Pranmudra, Apanmudra, Vyanmudra, Uddanmudra
- Role of yoga in sports
- 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, First aid related with respiratory system. First aid related with Heart, Blood and Circulation. First aid related with Wounds and Injuries. First aid related with Bones, Joints Muscle related injuries. First aid related with Nervous system and Unconsciousness. First aid related with Gastrointestinal Tract. First aid related with Skin, Burns. First aid related with Poisoning. First aid related with Bites and Stings. First aid related with Sense organs, Handling and transport of injured traumatized persons. Sports injuries and their treatments.

NCC- I

1(0+1)

Objective

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

Practical/ Awareness activities

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

- Sizing, numbering, forming in three ranks, open and close order march, and dressing.
- Saluting at the halt, getting on parade, dismissing, and falling out.
- Marching, length of pace, and time of marching in quick/slow time and halt. Side pace, pace forward and to the rear. Turning on the march and wheeling. Saluting on the march.
- Marking time, forward march, and halt. Changing step, formation of squad and squad drill.
- Command and control, organization, badges of rank, honors, and awards
- Nation Building- cultural heritage, religions, traditions, and customs of India. National integration. Values and ethics, perception, communication, motivation, decision making, discipline and duties of good citizens. Leadership traits, types of leadership.

Character/personality development. Civil defense organization, types of emergencies, firefighting, protection. Maintenance of essential services, disaster management, aid during development projects.

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

NSS- II

1(0+1)

Objective

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.

Practical/ Awareness activities

- Orientation: history, objectives, principles, symbol, badge; regular programmes under NSS
- Organizational structure of NSS, Code of conduct for NSS volunteers, points to be considered by NSS volunteers' awareness about health.
- NSS programme activities. Concept of regular activities, special camping, day camps, basis of adoption of village/slums, conducting survey, analyzing guiding financial patterns of scheme, youth programmes/ 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.

- Community mobilization. Mapping of community stakeholders, designing the message as per problems and their culture; identifying methods of mobilization involving youth-adult partnership. Social harmony and national integration
- 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

NSS-I1(0+1) PLEASE CHECK CONTENTS

Objective

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

Practical/ Awareness activities

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

movement. Movement with/without arms. Section battle drill. Types of communication, media, latest trends and developments.

NSS- II

1(0+1)

Objective

To evoke social consciousness among students through various activities viz., working together, constructive, and creative social work, to be skillful 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.

Practical/ Awareness activities

- Importance and role of youth leadership
- Meaning, types and traits of leadership, qualities of good leaders; importance and roles of youth leadership, Life competencies
- Definition and importance of life competencies, problem-solving and decision-making, interpersonal communication. Youth development programmes
- Development of youth programmes and policy at the national level, state level and voluntary sector; youth-focused and youth-led organizations
- Health, hygiene and sanitation. Definition needs and scope of health education; role of food, nutrition, safe drinking water, water borne diseases and sanitation (Swachh Bharat Abhiyan) for health; national health programmes 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

Chapter 7

UGC SKILL COURSES

UGC recommended list of skill development training areas

In addition to skill development training courses identified by respective universities from respective disciplines of study, such as agriculture, agribusiness, horticulture, forestry etc, Skill development courses may also be selected by universities from the following list of skill trainings advised in the UGC notification. “Guidelines for the Introduction of Short –Term Skill Development Courses in Higher Educational Institutions”. The UNIVERSITY/ COLLEGE may select any number of short-term skill development courses from the broad areas as mentioned below, in which they will have built institutional capacity for training or joined partnership with specialized institution capable of imparting such training program. The courses may be planned as integrated part of the UG-Certificate and UG-Diploma Programmes (after suitable planning of the contents) or they may be offered in standalone mode leading to award of certificates on the skill areas.

- i. Artificial Intelligence, and machine learning,
- ii. Artificial Intelligence, and Robotics
- iii. IoT (Internet of Things)/ Industrial IoT/Smart Cities
- iv. Data Science and Analytics
- v. Cloud Computing
- vi. Virtual Reality, Augmented Reality and Extended Reality
- vii. Cyber Security and Digital Forensics
- viii. 5G Connectivity
- ix. Digital Fluency/ Digital transformation
- x. Industrial Automation and Robotics Process Automation (RPA)
- xi. Electronic System Designs/ VLSI Designs
- xii. Electronic Manufacturing
- xiii. Basic Coding in Computing Languages
- xiv. Computer-Aided Design (CAD)/ Computer-Aided Manufacturing (CAM)
- xv. Mechanical Tooling and Processes/ Mechatronics
- xvi. Architectural Drafting, Basic 3D Design
- xvii. Building Information Modelling (BIM)
- xviii. 3D Printing
- xix. Electrician/Electrical & Electronics
- xx. Mobile Communication, Mobile Repairing and Basics of DTH Installation
- xxi. Digital Marketing - courses in Search Engine Optimization (SEO), social media marketing, content marketing, and e-commerce management
- xxii. Health and Wellness - courses focusing on mental health counselling, nutrition and dietetics, and fitness training in response to the growing awareness of personal well-being and holistic health & wellness
- xxiii. Financial Technology (FinTech) - courses in digital payments, blockchain technology, digital currencies, and financial regulations
- xxiv. Fashion Technology, Fashion design, stitching, etc. (home science colleges)
- xxv. Yogic Sciences
- xxvi. Soft skills and courses in effective communication, critical thinking and problem-solving, creative thinking and innovation, novel and adaptive thinking, design thinking

- and mindset, computational thinking, virtual collaboration, cross-cultural competency, new media literacy, team building, etc.
- xxvii. Basics of start-ups and Entrepreneurship – leadership, project planning, management, Event Management, marketing, financing, and **agri-business entrepreneurship**, etc.

The university / college may also offer short-term courses in any other areas identified by it, based on the skill gap studies as well as institutional expertise, e.g. agriculture, horticulture, Home science etc.

The skill courses run by various Sector Skill Councils can also be adopted.

Chapter 8

SYLLABI OF DIFFERENT DISCIPLINES

Course Curricula
for
Undergraduate programme
in
Agriculture
UG- Certificate in Agriculture
UG- Diploma in Agriculture
B.Sc. (Hons)Agriculture

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INTRODUCTION

Present report is an outcome of the valuable suggestions and recommendations of Sixth Deans' Committee members after having multi-stage in-depth deliberations and discussions in virtual and physical meetings as well as personal communications with the Deans and faculty members of the Agriculture discipline of different SAUs and Central Agricultural Universities, stakeholders from related industries, Govt. Institutions, alumni and students of the existing course programme across the country.

Restructuring of Undergraduate programme of Agriculture has been carried out as per National Education Policy 2020 guidelines to build among students, a strong foundation of knowledge and increased practical exposure to instill competence and confidence for application of the professional knowledge coupled with hard and soft skills. New scientific advancements in the field of agriculture have been also given due emphasis with inclusion of courses with contents from such areas.

More emphasis has been given on Skill enhancement courses, industry attachments, flexibility in choice of courses via electives offered in fourth year and also through online courses along with provision of project work and internship. Provision of UG-Certificate in Agriculture, UG-Diploma in Agriculture and B.Sc(Hons) Agriculture degree with internship with amalgamation of multiple exit and entry options as per NEP 2020 is important change in the course curriculum.

The detailed report on undergraduate courses of Agriculture viz. UG-certificate in Agriculture, UG-diploma in Agriculture and B.Sc(Hons) Agriculture has been prepared with due care and inputs of Deans, Heads and faculty members of various departments of agriculture, nationwide.

HIGHLIGHTS

- The B. Sc (Hons) Agriculture program will be of 177 credits, which will have 167 credits offered by the parent university and 10 credits of online courses taken by the student as per his/ her choice in consultation with university/HAEIs.
- After the admission in the college, the students will register for the Foundation programme of 2 weeks' duration in the 1st semester. A course entitled "*Deeksharambh*" (0+2) (Non-gradual) will be offered at the start of first semester for two weeks' duration. This will create a platform for students to learn from each other's life experiences, help for cultural Integration of students from different backgrounds, know about the operational framework of academic process in university, instilling life and social skills, social Awareness, ethics and values, team work, leadership, creativity, etc.. It will also help in identifying 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 & research managers.
- The first year of the course programme comprises of skill development courses along with other fundamental courses of agricultural science. After satisfactory completion of 42 credits of courses in two semesters of 1st year and subsequent satisfactory completion of 10 credits (10 weeks) of industry/ institute training/ internship, the student will become eligible for the award of UG-Certificate in Agriculture on exit. The students continuing the study further, would not have to attend the internship after 1st year.
- The second year has been designed with the skill development courses, basic courses as well as fundamental courses in agriculture with adequate theory and practical components, enabling the student to get acquainted with the basic principles and applications of agricultural sciences. After satisfactory completion of the courses (84 credits) during first two years and subsequent satisfactory completion of 10 credits (10 weeks) of internship, the student will become eligible for the award of UG-Diploma in Agriculture on exit. The students continuing the study further, would not have to attend the internship after 2nd year.
- During the 5th semester, the students will have a study tour of 10-12 days duration, which will be counted as 2 credits (Non-gradual).
- The third and fourth year courses have been designed to impart specialized knowledge to the students in the major disciplines. During the 7th semester, the students will adequately select 20 credits from a basket of elective courses, each course being of 4 credits giving an opportunity to them to gain advanced knowledge in frontier areas of agricultural science. The Universities will have flexibility to include more courses as Electives depending on specific needs and situational variations. The objective is to enable the student to acquire deeper understanding in any particular field.
- In the 8th semester of the course the major focus has been on strengthening of the knowledge and skill for developing confidence of the students to take entrepreneurship as their future career. For this they will undergo an advanced skill enhancement through Student READY programme (Rural Entrepreneurship in Agriculture Development Yozna) which will have segments as i(RAWE (Rural Awareness Work Experience) ii) Student project work and internship (10+10 credits), iii) Internship (20 credits) iii) Elective with student project work (10+10 credits) /Experiential Learning / Hands on Training/Industrial attachment. A student will select option/s on choice to complete the degree and pursue future career with 20 credits. Each student will be attached to a mentor either from the institution or from an organization/ industry. A university or a college will have the freedom to select the options as referred above.
- The core and elective courses can also be modified maximum up to 30% with approval from competent authority of the University.

- The students will take a minimum of 12 credits of online courses during four years as a partial requirement for the B.Sc(Hons) Agriculture programme. The indicative list of courses have been provided, however, online courses can be from any field such as Agriculture and allied sciences, Basic Sciences, Humanities, Psychology, Anthropology, Economics, Business Management, Languages including foreign language, Communication skills/ Music, etc. and can be taken from NPTEL, mooKIT, edX, Coursera, SWAYAM or any other such reputed portal. The objective is to allow the students to groom their passion or strengthen their knowledge and competency in any field beyond prescribed courses. These online courses will be non-gradual and separate certificates would be issued by institute/organization 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. A student must submit the list of online courses along with the content he intends to undertake to the Dean/Assoc. Dean/Principal of the college for a permission and records.
- At each stage of exit (UG-certificate/ UG-Diploma and B.Sc (Hons) Agriculture, the students are expected to acquire competency and confidence to get jobs, to face the real challenges in varied jobs and research, as well as to start their own enterprise. The social skills acquired by the students will also make the students more empathetic towards the society and social issues.
- The credits (and contact hours) have been designed in such a way that along with class room teaching, the students will take up NSS/ NCC and Physical Education, Yoga, etc. in the first year as the case may. Further a balance has been made by inclusion of common courses, core courses in basic and applied areas, skill development courses, elective courses in advanced areas, online courses of choice, options for entrepreneurship and skill development to pursue future career. This will increase their acquaintance with the social/ technical problems, improve their analytical ability of the issues/ challenges and enhance their social responsibility.

Entry and Exit Options

The entry and exit options for the UG programme in Agriculture are shown in the Fig.-1 below.

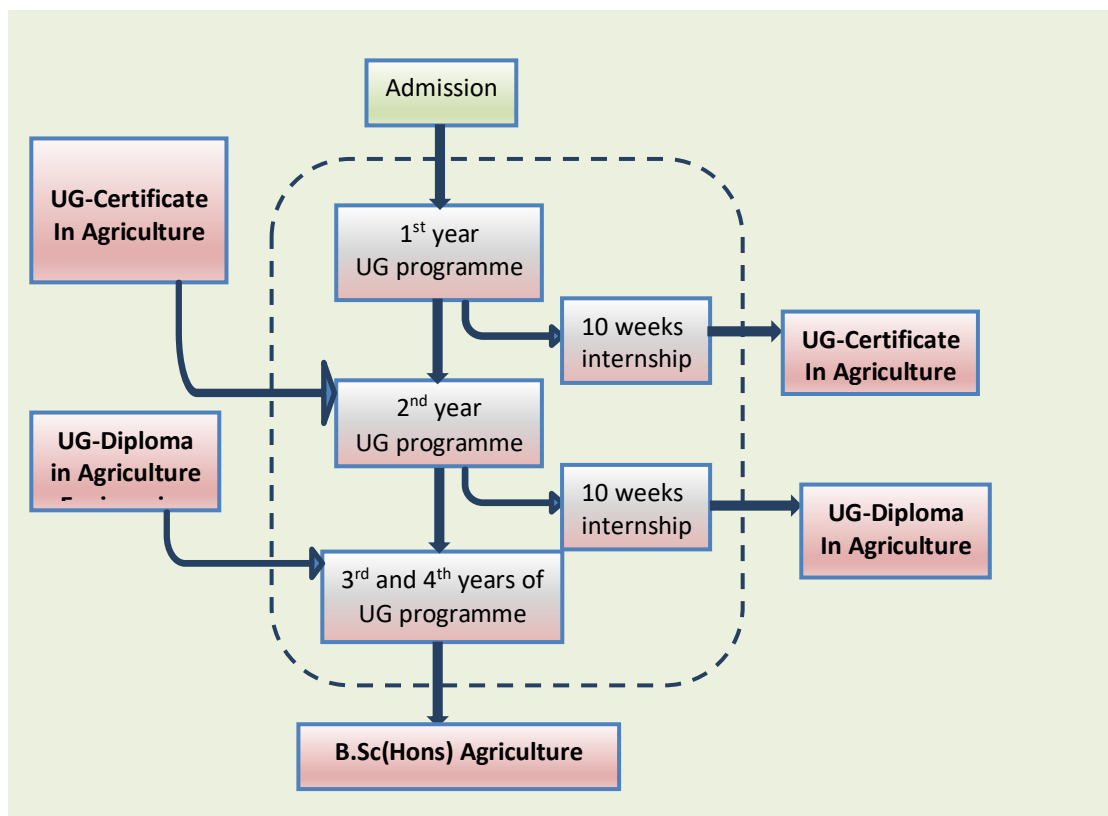


Fig. 1 Entry and Exit options for the UG programme in Agriculture

Exit options

1. **UG-Certificate in Agriculture** (exit after first year and completion of 10 weeks' internship)
2. **UG-Diploma in Agriculture** (exit after second year and completion of 10 weeks' internship)
3. **B. Sc (Hons)Agriculture** (on successful completion of four-year degree requirements)

Eligibility for Entry into 1st year UG programme: +2 Science with biology as one subject

Provision for multiple exit and entry into the UG programme in agriculture has been made in the light of NEP 2020. A student may exit after completion of 1st year and 2nd year requirements followed by 10 weeks of internship after 1st year and 2nd year, respectively to get UG-Certificate in Agriculture and UG-Diploma in Agriculture.

The Universities may consider allowing lateral entry for the candidates having Diploma in Agriculture (as such courses are available in many states and lateral entry is practiced in some Universities). In such cases, the candidates having Diploma in Agriculture (with minimum 3 years course programme after 10th or equivalent) may be allowed admission into the 2nd year of the UG programme, as per the provisions to be notified by the respective AU from time to time.

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ACADEMIC PROGRAMME
Semester wise course and credits Allocation

[Type text]

S. No	Course Title	Credit Hours	Total credit hours
First year			
I Semester			
1	Induction cum Foundation course (Deekshaarambh)	1 week (NG) Non-gradial	21(11+10)21
2	Skill Enhancementcourse-I	2(0+2)	
3	Skill Enhancementcourse-II	2(0+2)	
4	Communication Skills	2(1+1)	
5	Fundamentals of Agronomy	3(2+1)	
6	Fundamentals of Soil Science	3(2+1)	
7	Fundamentals of Horticulture	3(2+1)	
8	Farming based livelihood systems	3 (2+1)	
9	Rural Sociology and Educational Psychology	2 (2+0)	
10	National Service Scheme(NSS-I)/ National Cadet Corps(NCC-I)	1(0+1)	
11	Introductory mathematics (need based)	1(1+0) Non-gradiel	
II Semester			
1	Skill Enhancementcourse-III	2(0+2)	21(10+11)
2	Skill Enhancementcourse-IV	2(0+2)	
3	Personality Development	2(1+1)	
4	Environmental Studies and Disaster Management	3(2+1)	
5	Soil Fertility Management	3(2+1)	
6	Fundamentals of Entomology	3(2+1)	
7	Livestock and Poultry Management	2(1+1)	
8	Fundamentals of Plant Pathology	3(2+1)	
9	NCC-II/NSS-II	1(0+1)	
Second year			
III Semester			
1	Skill Enhancementcouse-V	2(0+2)	21(10+11)
2	Entrepreneurship Development and Business Communication	3 (2+1)	
3	Physical Education, First Aid and Yoga Practices	2(0+2)	
4	Principles of Genetics	3(2+1)	
5	Crop Production Technology-I (Kharif crops)	3(2+1)	
6	Production Technology of Fruit and Plantation Crops	2 (1+1)	
7	Fundamentals of Extension Education	2(1+1)	

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8	Fundamentals of Nematology	2(1+1)	
9	Principles and Practices of Natural Farming	2(1+1)	
	IV Semester		
1	Skill Enhancement course-VI	2(0+2)	21(12+9)
2	Agri informatics	3(2+1)	
3	Production Technology of Vegetables and Spices	2(1+1)	
4	Principles of Agricultural Economics and Farm Management	2(2+0)	
5	Crop Production Technology-II (Rabi Crops)	3(2+1)	
6	Farm Machinery and Power	2 (1+1)	
7	Water Management	2 (1+1)	
8	Problematic Soils and their management	2(1+1)	
9	Basics of Plant Breeding	3(2+1)	
Third year			
V Semester			
1	Agricultural Marketing and Trade	3 (2+1)	22(13+9)
2	Introduction to Agro-meteorology	2(1+1)	
3	Fundamentals of Crop Physiology	3(2+1)	
4	Pest management in Crops and Stored Grains	3 (2+1)	
5	Diseases of Field & Horticultural Crops & their Management	3(2+1)	
6	Crop Improvement - I	2 (1+1)	
7	Weed Management	2(1+1)	
8	Ornamental Crops, MAPs and Landscaping	2 (1+1)	
9	Introductory Agro forestry	2 (1+1)	
	VI Semester		
1	Fundamentals of Agri Biotechnology	3(2+1)	21(12+9)
2	Basic and Applied Agril. Statistics	3(2+1)	
3	Crop Improvement - II	2(1+1)	
4	Renewable energy in Agriculture and Allied Sector	2(1+1)	
5	Dryland agriculture/ Rainfed agriculture and watershed management	2(1+1)	
6	Essentials of Plant Biochemistry	3 (2+1)	
7	Agricultural Microbiology and Phyto -remediation	2(1+1)	
8	Agricultural Finance & Cooperation	2(1+1)	
9	Fundamentals of Seed Science & Technology	2(1+1)	

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Fourth year			
VII Semester			
1	5 Elective Courses (major or minor) each of 4(3+1) credits for B.Sc (Hons) Agriculture degree		20(15+5)
VIII Semester			
1	<u>For B.Sc (Hons)Agriculture Degree</u> Student READY (RAWEP/ Industrial Attachment /Experiential Learning / Hands on Training/ Project Work / Internship		20 Credits
		Total	167
	*Online courses	10	10
		Grand Total	167+10*

Department/section wise course breakup

S. No	Course title	Credit Hours	Total
Agronomy			
1	Fundamentals of Agronomy	3(2+1)	22(13+9)
2	Farming based livelihood systems	3 (2+1)	
3	Crop Production Technology-I (Kharif Crops)	3 (2+1)	
4	Crop Production Technology-II (Rabi Crops)	3(2+1)	
5	Water Management	2 (1+1)	
6	Weed Management	2(1+1)	
7	Introductory Agro forestry	2 (1+1)	
8	Dryland agriculture/ Rainfed agriculture and watershed management	2(1+1)	
9	Principles and Practices of Natural Farming	2(1+1)	
Soil Science:			
1	Fundamentals of Soil Science	3(2+1)	8(5+3)
2	Soil Fertility Management	3(2+1)	
2	Problematic Soils and their management	2(1+1)	
Horticulture			
1.	Fundamentals of Horticulture	3(2+1)	9(5+4)
2.	Production Technology of Fruit and Plantation Crops	2(1+1)	
3.	Production Technology of Vegetables and Spices	2(1+1)	
4.	Ornamental Crops, MAPs, , and Landscaping	2(1+1)	
Genetics and Plant Breeding			
1.	Principles of Genetics	3(2+1)	12(7+5)
2.	Basics of Plant Breeding	3(2+1)	
3.	Crop Improvement - I	2 (1+1)	
4.	Crop Improvement - II	2(1+1)	
5.	Fundamentals of Seed Science and Technology	2(1+1)	
Entomology			
1.	Fundamentals of Entomology	3(2+1)	6(4+2)
2.	Pest management in Crops and Stored Grains	3(2+1)	
Plant Pathology:			
1.	Fundamentals of Plant Pathology	3(2+1)	8(5+3)
2.	Diseases of Field & Horticultural Crops & their Management	3(2+1)	
3.	Agricultural Microbiology and Phyto-remediation	2(1+1)	

Extension Education			
1.	Rural Sociology and Educational Psychology	2 (2+0)	8(5+3)
2.	Fundamentals of Extension Education	2 (1+1)	
3.	Communication skills	2 (1+1)	
4.	Personality development	2(1+1)	
Agricultural Meteorology			
1.	Environmental Studies and Disaster mgt.	3(2+1)	5(3+2)
2.	Introduction to Agro-meteorology	2(1+1)	
Agricultural Economics			
1.	Principles of Agricultural Economics and Farm Management	2(2+0)	9(6+3)
2	Entrepreneurship Development and Business Communication	3 (2+1)	
3	Agricultural Marketing and Trade	2 (1+1)	
4.	Agricultural Finance & Cooperation	2(1+1)	
Agricultural Statistics			6(4+2)
1.	Agri informatics	3(2+1)	
2.	Basic and Applied Agril. Statistics	3(2+1)	
3.	Introductory Mathematics	1(1+0)	Non gradiel
Agricultural Engineering			
1.	Farm Machinery and Power	2 (1+1)	4(2+2)
2.	Renewable energy in Agriculture and Allied Sector	2(1+1)	
	Nematology		
1.	Fundamentals of Nematology	2(1+1)	2(1+1)
	Biochemistry		
1.	Essentials of Plant Biochemistry	3 (2+1)	3 (2+1)
	Crop Physiology		
1.	Fundamentals of Crop Physiology	3(2+1)	3(2+1)
	Animal Husbandry		
1.	Livestock and poultry Management	2(1+1)	2(1+1)
	Agricultural Bio-technology		
1.	Fundamentals of Agri Biotechnology	3(2+1)	3(2+1)
1.	Students' Welfare NCC/NSS	1(0+1)	1(0+1)
2.	NCC/NSS	1(0+1)	1(0+1)

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3.	Physical Education, First Aid and Yoga Practices	2(0+2)	2(0+2)
4.	Study Tour	2(0+2)	2(0+2) Non gradiel
*Elective Courses (Indicative)			
1	Agri-Business Management	4(3+1)	20*(15+5) 5* Elective Courses
2	Management of natural resources	4(3+1)	
3	Agrochemicals	4(3+1)	
4	Agricultural Journalism	4(3+1)	
5	Landscaping	4(3+1)	
6	Commercial Plant breeding	4(3+1)	
7	Food safety and standards	4(3+1)	
8	Bioformulation and Nanoformulation	4(3+1)	
9	Biopesticides and Biofertilizers	4(3+1)	
10	System Simulation and Agroadvisory	4(3+1)	
11	Hi-tech Horticulture	4(3+1)	
12	Protected cultivation	4(3+1)	
13	Climate Resilient Agriculture	4(3+1)	
14	Biotechnology of Crop Improvement	4(3+1)	
15	Geoinformatics and Remote Sensing, precision farming	4(3+1)	
16	Micro-propagation Technologies	4(3+1)	
17	Commercial Seed Production	4(3+1)	
18	Principles and Practices of Organic Farming/ Conservation Agriculture	4(3+1)	
19	Food Science and Nutrition	4(3+1)	
20	Post Harvest Technology and Value Addition		
**Skill enhancement courses (SECs)			
1.	SEC-I	2(0+2)	12(0+12)
2.	SEC-II	2(0+2)	
3.	SEC-III	2(0+2)	
4.	SEC-IV	2(0+2)	
5.	SEC-V	2(0+2)	
6.	SEC-VI	2(0+2)	

***Host institution may add more courses into this list**

**** SEC will be decided by host institution depending on strength**

Summary of credit distributions among different categories of courses

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

- ⁽¹⁾Deeksharambh (Induction-cum-Foundation Course) of 2 credits (2 weeks duration).
- ⁽²⁾Remedial Course: Mathematics of 1 credit
- ⁽³⁾Farming based Livelihood systems
- ⁽⁴⁾NCC/NSS
- ⁽⁵⁾Communication Skills
- ⁽⁶⁾ Environmental Studies and Disaster management
- ⁽⁷⁾Personality development
- ⁽⁸⁾ Entrepreneurship Development and Business Management
- ⁽⁹⁾Physical Education, First Aid and Yoga Practices
- ⁽¹⁰⁾Agri informatics
- ⁽¹¹⁾ Agricultural Marketing & Trade
- ⁽¹²⁾ Study tour (10-14 days)
- ⁽¹³⁾ Only for those opting for an exit with UG-Certificate and ⁽¹⁴⁾ Only for those opting for an exit with UG-Diploma
- ⁽¹⁵⁾Online course: student will make his own planning and execution of online courses with intimation to the Dean

ABSTRACT

Core courses

i) Major	:	80 credits
ii) Minor	:	32 credits

Skill Enhancement courses : 12 credits

Common courses : 19 credits

NCC/NSS : 02 credit

Physical Education, First Aid and Yoga Practices : 02 credits

Student READY/Internship : 20 credits

*MOOC courses (compulsory non-gradual) : 10 credits

Grand Total :167+10* Credits

List of Courses as per above Categories

Course category	Course title	Credit Hours
Induction cum Foundation course	Deeksha Arambh	2 weeks (Non-gradual)
Common courses	Farming based livelihood systems	3(2+1)
	Communication skill	2 (1+1)
	Personality development	2(1+1)
	Environmental studies and disaster management	3(2+1)
	Agricultural informatics	3(2+1)
	Entrepreneurship Development and Business Management	3(2+1)
	Agricultural Marketing & Trade	3(2+1)
	NSS/ NCC-I	2 courses each of 1(0+1) credits
	Physical Education, First Aid and Yoga Practices	2 credits
	Total credits	23
Core Courses	Fundamentals of Agronomy	3(2+1)
	Crop Production Technology-I (Kharif Crops)	3 (2+1)
	Crop Production Technology-II (Rabi Crops)	3(2+1)
	Water Management	2 (1+1)
	Weed Management	2(1+1)
	Introductory Agro forestry	2 (1+1)
	Dryland agriculture/ Rainfed agriculture and watershed management	2(1+1)
	Principles and Practices of Natural Farming	2(1+1)
	Fundamentals of Soil Science	3(2+1)
	Soil Fertility Management	3(2+1)
	Problematic Soils and their management	2(1+1)
	Fundamentals of Horticulture	3(2+1)
	Production Technology of Fruit and Plantation Crops	2(1+1)
	Production Technology of Vegetables and Spices	2(1+1)
	Ornamental Crops, MAPs, , and Landscaping	2(2+1)
	Principles of Genetics	3(2+1)
	Basics of Plant Breeding	3(2+1)
	Crop Improvement - I	2 (1+1)
	Crop Improvement - II	2(1+1)
	Fundamentals of Seed Science Technology	2(1+1)
	Fundamentals of Entomology	3(2+1)
	Pest management in Crops and Stored Grains	3 (2+1)

	Fundamentals of Plant Pathology	3(2+1)
	Diseases of Field & Horticultural Crops & their Management	3(2+1)
	Agricultural Microbiology and Phyto -remediation	2(1+1)
	Rural Sociology and Educational Psychology	2 (2+0)
	Fundamentals of Extension Education	2(1+1)
	Introduction to Agro-meteorology	2(1+1)
	Principles of Agricultural Economics and Farm Management	2(2+0)
	Agricultural Finance & Cooperation	2(1+1)
	Basic and Applied Agril. Statistics	3(2+1)
	Farm Machinery and Power	2 (1+1)
	Renewable energy in Agriculture and Allied Sector	2(1+1)
	Fundamentals of Nematology	2(1+1)
	Essentials of Plant Biochemistry	3 (2+1)
	Fundamentals of Crop Physiology	3(2+1)
	Livestock and poultry Management	2(1+1)
	Fundamentals of Agri Biotechnology	3(2+1)
	TOTAL	92
Elective Courses	20 credits will be taken from list of choice based course list or departmentwise courses to be decided by host institution	20
	TOTAL	20
Skill Enhancement Courses (indicative)	SDC-I (Biofertilizer and biopesticide production)	2(0+2)
	SEC-II(Mushroom production technology)	2(0+2)
	SEC-III (Seed production technology)	2(0+2)
	SEC-IV (Post harvest processting technology)	2(0+2)
	SEC-V (Beneficial insect farming)	2(0+2)
	SEC-VI(Horticulture nursery management)	2(0+2)
	SEC-VII(Plantation crops production and management)	2(0+2)
	TOTAL	12
Students READY		10+10
	TOTAL	20
Other courses	Remedial course on 1. Mathematics	1 credit Non-gradiel
	Study tour(2 weeks in 5 th semester)	2(0+2) Non-Gradial
	Total for offline course credits	167
Online courses	*Online courses	10

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	TOTAL	10
	Grand Total	167+10*

DETAILED SYLLABI**Semester 1**

S. No.	CourseTitle	Credithours
1	Induction-cum-Foundation course (Deeksha Arambh)	2 weeks (NG)
2	Skill Enhancementcourse	2(0+2)
3	Skill Enhancementcourse	2(0+2)
4	Communication Skills	2(1+1)
5	Farming based livelihood systems	3 (2+1)
6	Rural Sociology and Educational Psychology	2 (2+0)
7	Fundamentals of Agronomy	3(2+1)
8	Fundamentals of Soil Science	3(2+1)
9	Fundamentals of Horticulture	3(2+1)
10	NCC/ NSS	1(0+1)
11	Introductory mathematics (need based)	1(1+0) non-grdial
	Total	21(11+10)

Course Title: Induction cum Foundation Course(Deeksha Arambh)-Non gradial

Credit Hours: 1(1+0)

Objectives:

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

The details of activities will be decided by the parent universities. 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 & 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 identify the strength and weakness of students (with expert advice for their improvement) as well as to create a platform for students to learn from each other's life experiences
- iv. Activities to enhance cultural Integration of students from different backgrounds.
- v. Field visits to related fields/ establishments
- vi. Sessions on personality development (instilling life and social skills, social awareness, ethics and values, team work, leadership, etc.) and communication skills

Communication Skills2 (1+1)**Objectives:**

[Type text]

To acquire competence in oral, written and non-verbal communication, develop strong personal 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 verbals; phrases and clauses; Case: subjective case, possessive case; objective case; Correct usage of nouns, pronouns and antecedents, adjectives, adverbs and articles; Agreement of verb with the subject: tense, mood, voice; Writing effective sentences; Basic sentence faults;

Practical

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

Suggested readings

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7. Pease, Allan, 1998, Body Language. Sudha Publications, Delhi.
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Farming based livelihood systems

3 (2+1)

Objectives

- i) To make the students aware about farming based livelihood systems in agriculture
- ii) To disseminate the knowledge and skill how farming based systems can be a source of livelihood

Theory

Status of agriculture in India and different states, Income of farmers and rural people in India, Livelihood-Definition, concept and livelihood pattern in urban & 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 & 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 & success factors in farming based livelihood systems, Schemes & programmes by Central & State Government, Public & Private organizations involved in promotion of farming based livelihood opportunities. Role of farming based livelihood enterprises in

[Type text]

21st Century in view of circular economy, green economy, climate change, digitalization & changing life style.

Practical

Survey of farming systems and agricultural based livelihood enterprises, Study of components of important farming based livelihood models/ systems in different agro-climatic zones, Study of production and profitability of crop based, livestock based, processing based and integrated farming based livelihood models, Field visit of innovative farming system models. Visit of Agri-based enterprises & their functional aspects for integration of production, processing & 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 & profit analysis, Case study of Start-Ups in agri-sectors.

Suggested Readings

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

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 Sociology in Agricultural Extension, and Interrelationship between Rural Sociology & 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

& Caste System. Cultural concepts- Culture, Customs, Folkways, Mores, Taboos, Rituals and Traditions- Meaning, Definition and their Role in Agricultural Extension. Social Values and Attitudes – Meaning, Definition, Types and Role of Social Values and Attitudes in agricultural Extension. Social 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. J.B. Chitambar -Introductory Rural Sociology
2. Ray, G. L. -Extension Communication and Management
3. Dahama O. P. and Bhatnagar, O. P. - Education and Communication for Development
4. Sandhu A. S. -Textbook on Agricultural Communication
5. A. R. Desai -Rural Sociology in India
6. R Velusamy Textbook on Rural Sociology and Educational Psychology
7. M.B. Ghorpade- Essential of psychology
8. Web Materials
9. Prepared You Tube videos

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: Definitions of 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: 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, Concept of water availability to plants, soil-plant-water relationship, crop water requirement, water use efficiency, Methods of irrigation : Scheduling of irrigation, different approaches of scheduling irrigation

Weeds: Definition, Importance and basics of classification of weeds and their control

[Type text]

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, Measurement of soil moisture by gravimetric and volumetric method and bulk density, Determination of field capacity, Determination of gross and net irrigation requirement, Determination of infiltration rate

Suggested readings:

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

Fundamentals to Soil Science 3(2+1)

Objective: To impart knowledge on soil genesis, basic soil properties with respect to plant growth

Theory :

Soil- Pedological and edaphological concepts. Rocks and minerals, weathering, soil formation,, 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 of bulk density, 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,sStudy of infiltration rate of soil

Suggested readings:

1. Soil Fertility and Nutrient Management – By S. S. Singh, Kalyani Publishers
2. Introductory Soil Science – By Dilip Kumar Das, Kalyani Publishers
3. Soil Fertility and Fertilizers – By Samuel L. Tisdale, Werner L. Nelson and James D. Beaton, Macmillan Publishing Company, New York
4. The nature and Properties of Soils – By Harry O. Buckman and Nyle C.

Fundamentals of Horticulture 3 (2+1)

Objectives:

- To provide knowledge on different branches of horticulture viz. pomology, olericulture, floriculture and landscaping, spices and medicinal plants

[Type text]

- To provide knowledge on orchard management, propagation methods, cultural operations and nutrient management of horticultural crops
- To provide knowledge on different physiological aspects of horticultural crops

Theory:

- Horticulture-its different branches, importance & scope, Horticulture & botanical classification, soil and climate for horticultural crops, plant propagation- methods and propagation structures, seed dormancy and seed germination, 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, medicinal and aromatic plants, importance of bioregulators 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 K.L. Chadda

Course Title: National Cadet Corps (NCC) ,National Service Scheme (NSS)

Credit hours: 1(0+1)

National Cadet Corps- As per government guidelines, for getting B and C certificate in NCC, minimum years of requirement is 2 & 3 years along with 1-2 annual camps

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

National Service Scheme(NSS)

[Type text]

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 other than five regular one day camp in a year and one special camp for duration of 7 days at any semester break period in the two years. Different activities will include orientation lectures and practical works. Activities directed by the Central and State Government have to be performed by all the volunteers of NSS as per direction.

Introduction and Basic Components of NSS

- Orientation: history, objectives, principles, symbol, badge; regular programs under NSS
- organizational structure of NSS, Code of conduct for NSS volunteers, points to be considered by NSS volunteers' awareness about health.
- 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.
- Community mobilization. Mapping of community stakeholders, designing the message as per problems and their culture; identifying methods of mobilization involving youth-adult partnership. Social harmony and national integration
- 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

Semester II

S. No	Course title	Total credits
1	Skill Enhancement course	2(0+2)
2	Skill Enhancement course	2(0+2)
3	Personality Development	2(1+1)
4	Environmental Studies and Disaster mgt.	3(2+1)
5	Soil Fertility Management	3(2+1)
6	Fundamentals of Entomology	3(2+1)
7	Livestock and poultry Management	2(1+1)
8	Fundamentals of Plant Pathology	3(2+1)
9	NSS-II/NCC-II	1(0+1)

	Total	21(10+11)
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Course Title : Personality Development

Credits Hours : 2 (1+1)

Objectives:

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, Models of individual behavior, Perception and attributes and factors affecting perception, Attribution theory and case studies on Perception and Attribution. Learning: Meaning and definition, theories and principles of learning, Learning and organizational behavior, Learning and training, learning feedback. Attitude and values, Intelligence- types of Intelligence, theories of intelligence, measurements of intelligence, factors influencing intelligence, intelligence and Organizational behavior, emotional intelligence. Motivation- theories and principles, Teamwork and group dynamics.

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: Wadsworth

Environmental Studies and Disaster Management

Credits Hours : 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

[Type text]

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 Made Disasters - Nuclear disasters, chemical disasters, biological disasters, building fire, coal fire, forest fire, oil fire, road accidents, rail accidents, air accidents, sea accidents. International and National strategy for disaster reduction. Concept of disaster management, national disaster management framework; financial arrangements; role of NGOs, community-based organizations and media in disaster management. Central, state, district and local administration in disaster control; Armed forces in disaster response; Police and other organizations in disaster management.

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. DharChakrabarti. P.G., 2011. Disaster management - India's risk management policy frameworks and key challenges. Published by Centre for Social Markets (India), Bangalore. 36 pp.
 3. ErachBharucha, Text book for Environmental studies. University Grants Commission, New Delhi
 4. Parthiban, K.T. Vennila, S. Prasanthrajan, M. UmeshKanna, S. Forest, Environment, Biodiversity and Sustainable development. Narendra Publishing House, New Delhi, India 2023. (In Press).
 5. Prasanthrajan M, P.P. Mahendran., 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, Meerat, India
- Tyler Miller and Scot Spoolman. 2009. Living in the Environment (Concepts, Connections, and Solutions). Brooks/cole, Cengage learning publication, Belmont, USA

Course Title : Soil Fertility Management
Credits Hours : 3(2+1)

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

Theory :

Introduction and importance of manures and fertilizers. Fertilizer recommendation approaches. Integrated nutrient management. Chemical fertilizers: classification, composition and properties of major fertilizers, secondary & micronutrient fertilizers, Complex fertilizers, nano fertilizers Soil amendments, Fertilizer Storage, Fertilizer Control Order.

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 macro 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. Factor influencing nutrient use efficiency (NUE), methods of application under rainfed and irrigated conditions. STCR/RTNM/IPNS.

Practical :

Introduction of analytical instruments and their principles, calibration and applications of Colouremetry 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. Introductory Soil Science – By Dilip Kumar Das, Kalyani Publishers
3. Soil Fertility and Fertilizers – By Samuel L. Tisdale, Werner L. Nelson and James D. Beaton, Macmillan Publishing Company, New York
4. The nature and Properties of Soils – By Harry O. Buckman and Nyle C.

Course Title : Fundamentals of Entomology

Credits Hours :3 (2+1)

Objectives:

1. To know the history of entomology, classification of insects and their relationship with other arthropods
2. To study the various morphological characters of class insecta and their importance for classification of insects
3. To get an idea about the different physiological systems of insects and their 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 Insecta in Animal kingdom. Classification of phylum Arthropoda upto classes. Relationship of class Insecta 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. Structure of male and female genital organ. Metamorphosis and diapause in insects. Types of larvae and pupae. Structure and functions of digestive, circulatory, excretory, respiratory, nervous, secretory (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. Concept of IPM, Practices, scope and limitations of IPM. Classification of insecticides, toxicity of insecticides and formulations of insecticides. Systematics: Taxonomy – importance, history and development and binomial nomenclature. Definitions of Biotype, Sub-species, Species, Genus, Family and Order. Classification of class Insecta upto Orders, basic groups of present day insects with special emphasis to orders and families of Agricultural importance like Orthoptera: Acrididae, Tettigonidae, 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, Papilionidae, Noctuidae, Sphingidae, Pyralidae, Gelechiidae, Arctiidae, Saturniidae, Bombycidae; Coleoptera: Coccinellidae, Chrysomelidae, Cerambycidae, Curculionidae, Bruchidae, Scarabaeidae; Hymenoptera: Tenthredinidae, Apidae, Trichogrammatidae, Ichneumonidae, Braconidae, Chalcididae; Diptera: Cecidomyiidae, Tachinidae, Agromyziidae, Culicidae, Muscidae, Tephritidae.

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

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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) Imm's General Text book of Entomology— O.W. Rechards and R.G. Davies
- 2) Introduction to the study of Insects –D. J. Borror and DeLong's
- 3) Fundamentals of Ecology - Eugene.P. Odum & Gray W. Barrett
- 4) Integrated pest Management Concept and Approaches- G.S. Dhaliwal and Ramesh Arora

Course Title : Livestock and poultry Management

Credits Hours : 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 farming System

Theory:

Role of livestock in the national economy. Reproduction in farm animals and poultry. Housing principles, space requirements for different 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 feedstuffs. 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.

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 equipments. 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 text Book of Livestock Production management in Tropic by D. N. Verma

Course Title :Fundamentals of Plant Pathology

Credits Hours : 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 microorganisms causing 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 equipments, Study of different plant disease symptoms, Microscopic examination of general structure of fungi, Simple staining of bacteria: Direct and indirect staining, Gram staining of bacteria, Microscopic examination of fungal diseased specimen, Microscopic examination of bacterial diseased specimen, Preparation of culture media, Isolation of plant pathogens: Fungi, bacteria and viruses, Purification of plant pathogens, Study on plant disease diagnosis: Koch's Postulates, Characteristics, formulation, methods of application and calculation on fungicides

Suggested readings:

1. Pathak, V. N. Essentials of Plant Pathology. Prakash Pub., Jaipur
2. Agrios, GN. 2010. Plant Pathology. Acad. Press.
3. Kamat, M. N. Introductory Plant Pathology. Prakash Pub, Jaipur
4. Singh RS. 2008. Plant Diseases. 8 th Ed. Oxford & IBH. Pub. Co.
5. Singh RS. 2013. Introduction to Principles of Plant Pathology. Oxford and IBH Pub. Co.
6. Alexopoulos, Mims and Blackwel. Introductory Mycology
7. Mehrotra RS & Aggarwal A. 2007. Plant Pathology. 7 th Ed. Tata Mc Graw Hill Publ. Co. Ltd.
8. Gibbs A & Harrison B. 1976. Plant Virology - The Principles. Edward Arnold, London
9. Hull R. 2002. Mathew.s Plant Virology. 4th Ed. Academic Press, New York.
10. Verma JP. 1998. The Bacteria. Malhotra Publ. House, New Delhi.
11. Goto M. 1990. Fundamentals of Plant Bacteriology. Academic Press, New York.
12. Dhingra OD & Sinclair JB. 1986. Basic Plant Pathology Methods. CRC Press, London, Tokyo.
13. Nene YL & Thapliyal PN. 1993. Fungicides in Plant Disease Control. 3rd Ed. Oxford & IBH, New Delhi.
14. Vyas SC. 1993. Handbook of Systemic Fungicides. Vols. I-III. Tata McGraw Hill, New Delhi.
15. Rajeev K & Mukherjee RC. 1996. Role of Plant Quarantine in IPM. Aditya Books.
16. Rhower GG. 1991. Regulatory Plant Pest Management. In: Handbook of Pest Management in Agriculture. 2nd Ed. Vol. II. (Ed. David Pimental). CRC Press.

Course Title: National Cadet Corps (NCC) ,National Service Scheme (NSS)

Credit hours: 1(0+1)

National Cadet Corps (NCC)

- Arms Drill- Attention, stand at ease, stand easy. Getting on parade. Dismissing and falling out. Ground/take up arms, examine arms. Shoulder from the order and vice-versa, present from the order and vice-versa. Saluting at the shoulder at the halt and on the march. Short/long trail from the order and vice- versa. Guard mounting, guard of honor, Platoon/Coy Drill.
- Characteristics of rifle (.22/.303/SLR), ammunition, fire power, stripping, assembling, care, cleaning, and sight setting. Loading, cocking, and unloading. The lying position and holding.
- Trigger control and firing a shot. Range Procedure and safety precautions. Aiming and alteration of sight. Theory of groups and snap shooting. Firing at moving targets. Miniature range firing. Characteristics of Carbine and LMG.
- Introduction to map, scales, and conventional signs. Topographical forms and technical terms.

[Type text]

- The grid system. Relief, contours, and gradients. Cardinal points and finding north. Types of bearings and use of service protractor. Prismatic compass and its use. Setting a map, finding north and own position. Map to ground and ground to map. Knots and lashings, Camouflage and concealment, Explosives and IEDs.
- Field defences obstacles, mines and mine lying. Bridging, waterman ship. Field water supplies, tracks and their construction. Judging distance. Description of ground and indication of landmarks. Recognition and description of target. Observation and concealment. Field signals. Section formations. Fire control orders. Fire and movement. Movement with/without arms. Section battle drill. Types of communication, media, latest trends and developments.

National Service Scheme (NSS):

- Importance and role of youth leadership
- Meaning, types and traits of leadership, qualities of good leaders; importance and roles of youth leadership, Life competencies
- Definition and importance of life competencies, problem-solving and decision-making, interpersonal communication. Youth development programs
- Development of youth programs and policy at the national level, state level and voluntary sector; youth-focused and youth-led organizations
- Health, hygiene and sanitation. Definition needs and scope of health education; role of food, 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

Note:

- As per the guidelines of Ministry of Youth Affairs and Sports, GOI, minimum duration for a NSS volunteer to be eligible for Certificate-A is 2 years; for Certificate-B is 3 years and for Certificate-C is 4 years.
- Hence , additional contents for Semester III and Semester IV contents (optional) may be included by the College for securing those advanced certificates if interested students are there.

Semester III (optional)

- Vocational Skill development
- To enhance the employment potential and to set up small business enterprises skills of volunteers, a list of 12 to 15 vocational skills will be drawn up based on the local conditions and opportunities. Each volunteer will have the option to select two skill-areas out of this list of issues related environment.
- Environmental conservation, enrichment and sustainability, climatic change, natural resource management (rainwater harvesting, energy conservation, forestation, waste land development and soil conservations) and waste management. Disaster management. Introduction and classification of disaster, rehabilitation, and management after disaster; role of NSS volunteers in disaster management.
- Entrepreneurship development. Definition, meaning and quality of entrepreneur; steps in opening of an enterprise and role of financial and support service institution.
- Formulation of production-oriented project. Planning, implementation, management, and impact assessment of project. Documentation and data reporting. Collection and analysis of data, documentation, and dissemination of project reports

Semester IV (optional)

[Type text]

- Youth and Crime
- Sociological and psychological factors influencing youth crime, cybercrime, peer mentoring in preventing crime and awareness for juvenile justice.
- Civil/self-defense. Civil defense services, aims and objectives of civil defense; needs and training of self-defense. Resource mobilization. Writing a project proposal of self-fund units (SFUs) and its establishment
- Additional life skills. Positive thinking, self-confidence, and esteem, setting life goals and working to achieve them, management of stress including time management.

Semester III

S. No	Course title	Total credits
1	Skill Enhancement	2(0+2)
2	Entrepreneurship Development and Business Communication	3 (2+1)
3	Physical Education, First Aid and Yoga Practices	2(0+2)
4	Principles of Genetics	3(2+1)
5	Crop Production Technology-I (Kharif crops)	3(2+1)
6	Production Technology of Fruit and Plantation Crops	2 (1+1)
7	Fundamentals of Extension Education	2(1+1)
8	Fundamentals of Nematology	2(1+1)
9	Principles and Practices of Natural Farming	2(1+1)
	Total	21(10+11)

Course Title : Entrepreneurship Development and Business Communication

Credits Hours : 3(2+1)

Objective:

- To provide student an insight into the concept and scope of entrepreneurship.
- To expose the student to various aspects of establishment and management of a small business unit.
- 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, importance of 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. Financial management /accounting – funds, fixed capital and working capital, costing and pricing, long term planning

[Type text]

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:

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

Course title: Physical Education, First Aid and Yoga Practices

Credit hours: 2 (0+2)

Objectives

- iii) To make the students aware about **Physical Education, First Aid and Yoga Practices**
- iv) To disseminate the knowledge and skill how to perform physical training, perform firstaid and increase stamina and general wellbeing through yoga.

Practical

Physical education; Training and Coaching - Meaning & Concept; Methods of Training; aerobic and aerobic exercises; Calisthenics, weight training, circuit training, interval training, Fartlek training; Effects of Exercise on Muscular, Respiratory, Circulatory & 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 & its Management; Posture; Postural Deformities; Exercises for good posture.

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

- Asanas (Definition and Importance) Padmasan, Gaumukhasan, Bhadrasan, Vajrasan, Shashankasan, Pashchimotasan, Ushtrasan, Tadasan, Padhas tasan, Ardhchandrasan, Bhujangasan, Utanpadasan, Sarvangasan, Parvatasan, Patangasan, Shishupalanasan – left leg-right leg, Pavanmuktasan, Halasan, Sarpasan, Ardhhdhanurasan, Sawasan
- SuryanamskarPranayama (Definition and Importance) Omkar, Suryabhedan, Chandrabhedan, Anulom Vilom, Shitali, Shitkari, Bhastrika, Bhramari
- Meditation(Definition and Importance), Yogic Kriyas (Kapalbhati), Tratak, Jalneti and Tribandh
- Mudras (Definition and Importance) Gyanmudra, Dhyamudra, Vayumudra, Akashmudra, Pruthvimudra, Shunyamudra, Suryamudra, Varunmudra, Pranmudra, Apanmudra, Vyanmudra, Uddanmudra

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- Role of yoga in sports
- 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, First aid related with respiratory system. First aid related with Heart, Blood and Circulation. First aid related with Wounds and Injuries. First aid related with Bones, Joints Muscle related injuries. First aid related with Nervous system and Unconsciousness. First aid related with Gastrointestinal Tract. First aid related with Skin, Burns. First aid related with Poisoning. First aid related with Bites and Stings. First aid related with Sense organs, Handling and transport of injured traumatized persons. Sports injuries and their treatments.

Course Title : Principles of Genetics

Credits Hours : 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, 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. Probability and Chi-square. Dominance relationships, Epistatic interactions with example.

Multiple alleles, pleiotropism and pseudoalleles, 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 and CIB technique, mutagenic agents and induction of mutation. Qualitative and quantitative traits, Polygenes and continuous variations, multiple factor hypothesis, Cytoplasmic inheritance, Genetic disorders, Nature, structure and replication of genetic material, Protein synthesis, Transcription and translational mechanism of genetic material, Gene concept: Gene structure, function and regulation, Lac and Trp operons.

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 cross-over analysis (through two point test cross and three 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. Principles of Genetics: Gardner, Simmons and Snustad.
3. Genetics: M. W. Strickberger.
4. Principles of Genetics: Sinnott, Dunn and Dobzhansky

Course Title : Crop Production Technology-I (Kharif crops)

Credits Hours : 3(2+1)

Objectives: i) To impart basic and fundamental knowledge on principles and practices of kharif crop production.

ii) 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 and finger millet,

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pulses- pigeonpea, mungbean and urbean; oilseeds- groundnut, and soybean; fibre crops- cotton & jute; forage crops- sorghum, cowpea, cluster bean and napier.

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

Suggested readings:

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

Course Title: Fundamentals of Extension Education

Credit Hours: 2 (1+1)

Objectives:

1. State the importance of extension education in agriculture.
2. Familiarize with the different types of agriculture and rural development programmes launched by 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 & Types; Extension Education- meaning, definition, scope and process; objectives and principles of Extension Education; Extension Programme planning- Meaning, Process, Principles and Steps in Programme Development. 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 programmes 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.

Rural Development: concept, meaning, definition; various rural development programmes launched by Govt. of India. Community Dev.-meaning, definition, concept & 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 programmes; 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 and Management in Extension, Concept publishing company, New Delhi.
4. MuthaiahManoraharan, P. and Arunachalam, R., Agricultural Extension, Himalaya Publishing House (Mumbai).
5. Sagar Mondal and Ray, G. L., Text Book on Rural Development, Entrepreneurship And Communication Skills, Kalyani Publications.
6. Rathore, O. S. et al., 2012, Handbook of Extension Education, Agrotech Publishing Academy, Udaipur.
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).Textbook on Agricultural Communication : Process and Methods. Oxford and 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

Course Title : Fundamentals of Nematology

Credits Hours : 2(1+1)

Objectives:

- i) To impart knowledge on history, economic importance of plant parasitic nematodes, morphology, biology, host parasitic relationship of nematodes.
- ii) To impart knowledge on nematode pests of different crops of national and local importance and 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 upto 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 upto 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. Text book on Introductory Plant Nematology -R.K.Walia and H.K.Bajaj
2. Plant Parasitic Nematodes (Vol-1) by Zukerman, Mai, Rohde

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3. Plant Parasitic Nematodes of India: Problems and Progress by - Gopal Swarup, D. R. Dasgupta, P. K. Koshy.
4. Economic Nematology-Edited by J.M. Webster

Course Title : Principles and Practices of Natural Farming
Credits Hours : 2 (1+1)

General Objectives: To provide comprehensive understanding and knowledge to students about natural farming

Specific Objectives: i) To teach students the concept, need and principles of native ecology-based production under natural farming

ii) To impart practical knowledge of natural farming and related agricultural practices in Indian and 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 farming and 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. Nalini S. 1999. Krishi-Parashara (Agriculture by Parashara) by Parashara. Brig Sayeed Road, Secunderabad, Telangana: AAHF Classic Bulletin, Asian Agri-History Foundation. 104pp.
2. Shamasastri R. 1915. Kautilya's Arthashastra.
3. Ayachit SM. 2002. Kashyapi Krishi Sukti (A Treatise on Agriculture by Kashyapa). Brig Sayeed Road, Secunderabad, Telangana: Asian Agri-History Foundation 4: 205.
4. Nalini S. 1996. Vrikshayurveda (The Science of Plant Life) by Surapala. AAHF Classic Bulletin 1. Asian Agri-History Foundation, Brig Sayeed Road, Secunderabad, AP (now Telangana), India. 94pp.
5. Ecological Farming -The seven principles of a food system that has people at its heart. May 2015, Greenpeace.
6. HLPE. 2019. Agroecological and other innovative approaches for sustainable agriculture and food systems that enhance food security and nutrition. A report by the High Level Panel of Experts on Food Security and nutrition of the Committee on World Food Security, Rome. <https://fao.org/3/ea5602en/ea5602en.pdf>.
7. FAO. 2018. The 10 elements of agro-ecology: guiding the transition to sustainable food and agricultural system .<https://www.fao.org/3/i9037en/i9037en.pdf> Agro ecosystem Analysis for Research and Development Gordon R. Conway.1985
8. UK Behera. 2013. A text Book of Farming System. Agrotech Publishing House, Udaipur.
9. (ISBN: 978-81-8321-309-7)
10. Hill S.B and Ott. P. (eds.). 1982 Basic Techniques in Ecological Farming Berkhauser Verlag, Basel, Germany, 366 pp.
11. 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
12. Boeringa R. (ed.). 1980. Alternative Methods of Agriculture. Elsevier, Amsterdam, 199 pp.
13. Ecological Farming, The Seven principles of a food system that has people at its heart. May 2015, Greenpeace
14. Fukuoka M. 1978. The One-Straw Revolution: An Introduction to Natural Farming. Rodale Press, Emmaus, PA. 181 pp
15. Fukuoka M. 1985. The Natural Way of Farming: The Theory and Practice of Green Philosophy. Japan Publications, Tokyo, 280 pp.
16. Hill S.B. and Ott P. (eds.). 1982. Basic Techniques in Ecological Farming. Berkhauser Verlag, Basel, Germany, 366 pp.
17. INFR. 1988. Guidelines for Nature Farming Techniques. Atami, Japan. 38 pp.
18. Khurana, A. and Kumar, V. 2020. State of Organic and Natural Farming: Challenges and Possibilities, Centre for Science and Environment, New Delhi.
19. Reyes Tirado. 2015. Ecological Farming- The seven principles of a food system that has people at its heart. Greenpeace Research laboratories. University of Exeter, OtthoHeldringstraat.
20. The Ultimate Guide to Natural Farming and Sustainable Living: Permaculture for Beginners (Ultimate Guides) by Nicole Faires (2016)
21. Plenty For All: Natural Farming A To Z PRAYOG PARIWAR METHODOLOGY by Prof. Shripad A. Dabholkar and Prayog Pariwar Prayog Pariwar (2021)
22. Natural Farming Techniques: Farming without tilling by Prathapan Paramu (2021)
23. Natural Asset Farming: Creating Productive and Biodiverse Farms by David B. Lindenmayer, Suzannah M. Macbeth, et al. (2022)
24. कमलागतप्राकृतिककृति: आचार्यदेवव्रत, pp 1-166.
25. Malhotra R. and S.D. Babaji. 2020. Sanskrit Non Translatable- The importance of Sanskritizing English. Amaryllis, New Delhi India.
26. 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

Semester IV

S. No	Course title	Total credits
1	Skill Enhancement course	2(0+2)
2	Agri informatics	3(2+1)
3	Production Technology of Vegetables and Spices	2(1+1)
4	Principles of Agricultural Economics and Farm Management	2(2+0)
5	Crop Production Technology-II (Rabi Crops)	3(2+1)
6	Farm Machinery and Power	2 (1+1)
7	Water Management	2 (1+1)
8	Problematic Soils and their management	2(1+1)
9	Basics of Plant Breeding	3(2+1)
	Total	21(12+9)

Course Title : Agri Informatics

Credits Hours : 3 (2+1)

Objective

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

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 database, Uses of DBM in Agriculture, Internet and World Wide Web (WWW): Concepts and components.

Computer programming: General concepts, Introduction to Visual Basic, Java, Fortran, C/ C++, etc. 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 analysis and crop simulation models, concepts, structure, 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, Smart phone 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 System 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.

Practical

Study of computer components, accessories, practice of important DOS Commands, Introduction of different operating systems such as Windows, Unix/ Linux, creating files & folders, File Management. Use of MS-WORD and MS Power-point for creating, editing and presenting as scientific documents, MS-EXCEL- Creating as spreadsheet, Use of statistical tools, Writing expressions, Creating graphs, Analysis of scientific data, Handling macros. MS-ACCESS: Creating Database, preparing queries and reports, Demonstration of

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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 smart phones and other devices in agro-advisory and dissemination of market information, Introduction of Geospatial Technology, Hands on practice on preparation of Decision Support System, Preparation of contingent crop planning, India Digital Ecosystem of Agriculture (IDEA)

Suggested Readings

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

Course Title : Production Technology of Vegetables and Spices
Credits Hours : 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 of vegetables and spices.
3. To educate about the physiological disorders of vegetables and spices

Theory

Importance of vegetables & 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, Brinjal, Chili, Capsicum, Cucumber, Melons, Gourds, 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)

Practical

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

Suggested readings:

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

Course Title : Principles of Agricultural Economics and Farm Management
Credits Hours : 2(2+0)

Objectives: 1. To aware the students about broad areas covered under agricultural Economics and farm management
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 in measurement. Population: Importance, Malthusian and Optimum population theories, natural and socio-economic determinants, current policies and programmes on population control. Money: Barter system of exchange and its problems, evolution, meaning and functions of money, classification of money, money supply, general price index, inflation and deflation. Economic systems: Concepts of economy and its functions, important features of capitalistic, socialistic and mixed economies, elements of economic planning. Forms of business organizations, international trade and balance of payments. GST and its implication on Indian economy.

Suggested readings:

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

Course Title : Crop Production Technology-II (Rabi Crops)
Credits Hours : 3(2+1)

Objectives: i) To impart basic and fundamental knowledge on principles and practices of rabi crop production.
ii) 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 Rabi crops; cereals- wheat and barley, pulses- chickpea, lentil, peas , oilseed- rapeseed, mustard and sunflower; sugar crops-sugarcane; medicinal and aromatic crops- mentha, lemon grass and citronella ,Forage crops –berseem, lucerne and oat.

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.

Suggested readings:

- B. Gurarajan, R. Balasubramanian and V.Swaminathan. Recent Strategies on Crop Production. Kalyani Publishers, New Delhi.
- Chidida Singh.1997. Modern techniques of raising field crops. Oxford and IBH Publishing Co. Pvt. Ltd., Delhi.
- Rajendra Prasad. Textbook of Field Crops Production - Commercial Crops. Volume II ICAR Publication.
- Rajendra Prasad. Textbook of Field Crops Production - Foodgrain Crops. Volume I ICAR Publication.
- S.R.Reddy. 2009. Agronomy of Field Crops. Kalyani Publishers, New Delhi.

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S.S.Singh. 2005. Crop Management. Kalyani Publishers, New Delhi.

UAS, Bangalore. 2011. Package of Practice. UAS, Bangalore.

Rajendra Prasad 2002. Text Book of Field crops Production, ICAR, New Delhi.

Reddy, S.R. 2004. Agronomy of Field crops, Kalyani Publishers, Ludhiana.

Subhash Chandra Bose, M. and Balakrishnan, V. 2001. Forage Production South Asian Publishers, New Delhi.

Course Title : Farm Machinery and Power
Credits Hours : 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 transplanter 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. Surendra Singh- Farm machinery –Principles and applications, ICAR, New Delhi
3. Jain, S.C. and C.R.Rai. Farm Tractor and maintenance and repair. Standard Publishers, 1705- B, Naisarak, Delhi- 110006
4. Ojha, T.P. and A.M.Michael, A.M. Principles of Agricultural Engineering. Vol.I. Jain brothers, 16/893, East Park Road, Karol Bagh, New Delhi -110005

Course Title : Water Management
Credits Hours : 2(1+1)

Objectives: i) To study the important properties of soil affecting water availability to crops and water requirement for optimum growth and development
ii) To study different methods of irrigation and water management practices of both field and horticultural crops and drainage.
iii) 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); Agricultural drainage. Water management problem, soils quality of irrigation water, irrigation management practices for different soils and crops., drip, sprinkler. Layout of underground pipeline system.

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 and weirs; 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; Determination of EC, pH, carbonates, bio-carbonates, Ca^{++} and Mg^{++} in irrigation water (quality parameters).

Suggested readings:

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

Course Title : Problematic Soils and their management
Credits Hours : 2 (1 + 1)

Objectives:

1. To acquaint the students about various problem soils like degraded soils, acid soils, saline soils, alkali soils, eroded soils, submerged soils, polluted soils. Also to impart knowledge about remote sensing, GIS, Multipurpose tree and Land capability classification

2. To give hands on training about estimation of various soil and water quality parameters associated with problem soils.

Theory

Soil quality and health, Distribution of Waste land and problem soils in India with special reference to Assam and North Eastern Region. 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. Management of Riverine soils, Waterlogged soils, Contaminated soils (Pesticide contamination, Heavy metal contamination), Mined soils (Coal mined, Oil mined),

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. Srivastava, V. C., 2002. Management of Problem Soils -Principles and Practices. AGROBIOS (India).
2. Osman, Khan Towhid, 2018, Management of Soil Problems. Springer publication
3. Indian Society of Soil Science, 2002. Fundamentals of Soil Science. IARI, New Delhi.
4. Brady Nyle C and Ray R Well, 2014. Nature and properties of soils. Pearson Education Inc., New Delhi.
5. Cirsan J. Paul, 1985, Principles of Remote Sensing. Longman, New York
6. Agarwal, R.R., Yadav, J.S.P. and Gupta, R.N. (1982). Saline Alkali soils of India, ICAR, New Delhi

Course Title : Basics of Plant Breeding

Credits Hours : 3(2+1)

Objectives: To acquaint with different 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, Domestication, Acclimatization and Introduction; Centres of origin/diversity, Components of Genetic variation; Heritability and genetic advance; 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; Maintenance of breeding records and data collection; Wide hybridization and pre-breeding; Polyploidy in relation to plant breeding, mutation breeding-methods and uses; Breeding for important biotic and abiotic stresses; Biotechnological tools-DNA markers and marker assisted selection. Participatory plant breeding; Intellectual Property Rights, Patenting, Plant Breeders & 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 & 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.

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 by GS Chahal and SS Gosal
5. Principles of Plant Genetics and Breeding by George Acquaah

Semester V

S. No	Course title	Total credits
1	Agricultural Marketing and Trade	3 (2+1)
2	Introduction to Agro-meteorology	2(1+1)
3	Fundamentals of Crop Physiology	3(2+1)
4	Pest management in Crops and Stored Grains	3 (2+1)
5	Diseases of Field & Horticultural Crops & their Management	3(2+1)
6	Crop Improvement - I	2 (1+1)
7	Weed Management	2(1+1)
8	Ornamental Crops, MAPs and Landscaping	2 (1+1)
9	Introductory Agro forestry	2 (1+1)
	Total	22(13+9)

Course Title : Agricultural Marketing and Trade

Credits Hours : 3(2+1)

Objectives:

- To understand the fundamentals of agricultural marketing and trade.
- To analyze the factors influencing supply and demand in agricultural markets.
- To explore different marketing channels and strategies in agriculture.
- 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 agri commodities: nature and determinants of demand and supply of farm products, producer's surplus – meaning and its types, marketable and marketed surplus, factors affecting marketable surplus of agri-commodities; pricing and promotion strategies: pricing considerations and approaches – cost based and competition based pricing; market promotion – advertising, personal selling, sales promotion and publicity – meaning, merits and demerits; marketing process and functions: Marketing process concentration, dispersion and equalization; exchange functions – buying and selling; physical functions – storage, transport and processing; facilitating functions – packaging, branding, grading, quality control and labelling (Agmark); Market functionaries and marketing channels: Types and importance of agencies involved in agricultural marketing; meaning and definition of marketing channel; number of channel levels; marketing channels for different farm products; Integration, efficiency, costs and price spread: Meaning, definition and types of market integration; marketing efficiency; marketing costs, margins and price spread; factors affecting cost of marketing; reasons for higher marketing costs of farm commodities; ways of reducing marketing costs;

Role of Govt. in agricultural marketing: Public sector institutions- CWC, SWC, FCI, CACP & DMI – their objectives and functions; cooperative marketing in India; Risk in marketing: Types of risk in marketing; speculation & 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 international trade 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.

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:

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

Sharma, R., 2005, Export Management, LaxmiNarain Agarwal, Agra.

Course Title : Introduction to Agro-meteorology
Credits Hours : 2(1+1)

Objectives:

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

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, longwave and thermal radiation, net radiation, albedo; Atmospheric temperature, temperature inversion, lapse rate, daily and seasonal variations of temperature, vertical profile of temperature, Energy balance of earth; Atmospheric humidity, concept of saturation, vapor 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 normals 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 soil temperature and computation of soil heat flux, Determination of vapor pressure and relative humidity, Determination of dew point temperature, Measurement of atmospheric pressure and analysis of atmospheric conditions, Measurement of wind speed and wind direction, preparation of windrose, Measurement, tabulation and analysis of rain, Measurement of open pan evaporation and evapotranspiration, Computation of PET and AET.

Suggested readings:

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

Course Title : Fundamentals of Crop Physiology
Credits Hours : 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 and factors affecting WUE.

Classification of mineral elements: Essential and beneficial elements, Passive and active transport of mineral element: Nernst equation, ion transport, ion pump and channels, Functions of essential elements and their deficiency and toxicity symptoms, Hydroponics and sand culture.

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 & II.

Introduction to light reaction of photosynthesis, Light absorption by photosynthetic pigments and transfer of energy, Source of O₂ during photosynthesis: Hill reaction, Brief introduction to cyclic and non-cyclic photophosphorylation: production of assimilatory powers.

Introduction to C₃, C₄ and CAM pathways: Calvin Cycle, Hatch & Slack Cycle, CAM Cycle, Significance of these pathways (concept of photorespiration, absence of photorespiration in C₄ plant: Productivity of C₄ plant, CAM: an adaptive mechanism), Factors affecting photosynthesis (light, temperature, CO₂, O₂ etc).

Outline of the process of respiration: Definition and importance, Glycolysis, Krebs Cycle and ETC, Factors affecting respiration (O₂, temperature, CO₂ 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. Short discussion on factors affecting growth and development.

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Photoperiodism: Classical works of Garner and Allard. Photoperiodic Classification of plants: Short Day Plant, Long Day Plant, Day Neutral plant etc. 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 Absciscic 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; 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.

Suggested readings:

- Plant Physiology by Robert M. Devlin and Francis H. Witham
- Plant Physiology by Lincoln Taiz and Eduardo Zeiger
- Plant physiology by Frank B. Salisbury and Cleon W. Ross
- Fundamentals of Plant Physiology by Lincoln Taiz, Eduardo Zeiger, Ian Max Mølle and Angus Murphy
- Devlin's Exercises in Plant Physiology by Robert Devlin, Francis H. Witham and David F. Blaydes

Course Title : Pest management in crops and stored grains

Credits Hours : 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.

Practical

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

Suggested readings:

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

Course Title : Diseases of Field & Horticultural Crops & their Management
Credits Hours : 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 horticultural crops

Theory:

Symptoms, etiology, disease cycle, epidemiology and management of major diseases of the following field and horticultural crops:

Fieldcrops_ 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, Cercospora Leaf 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).

Horticulturalcrops: 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,

[Type text]

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.

Students should submit 50 pressed and well mounted specimens

Suggested readings:

1. Plant Diseases (By: R.S. Singh)
2. Plant Disease Management: Principles and Practices (By: HridayChaube)
3. Integrated Plant Disease Management (By: R.C. Sharma)
4. Plant Pathology (By: G.N. Agrios, 2010)

Course Title : Crop Improvement - I

Credits Hours : 2(1+1)

- Specific 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; 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 Pigeonpea etc. Ideotype concept, climate resilient crop varieties for future.

Practical:

Floral biology, emasculation and hybridization techniques in different crop species viz. Rice, Jute, Maize, Sorghum, Pearl millet, Ragi, Pigeonpea, Urdbean, Mungbean, Soybean, Groundnut, Sesame, Castor, Cotton, Cowpea, Tobacco, Brinjal, Okra and Cucurbitaceous crops. Maintenance breeding of different kharif crops. Handling of germplasm and segregating populations by different methods like pedigree, bulk and single seed decent methods; Study of field techniques for seed production and hybrid seed production in kharif crops; Estimation of heterosis, inbreeding depression and heritability; Layout of field experiments; Study of quality characters, donor parents for different characters; Visit to seed production plots; Visit to AICRP breeding plots of different crops.

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

Course Title : Weed Management

Credits Hours : 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 competition, factors of competition, losses on growth and yield of crops; factors affecting growth and development. Concepts of weed management: physical, cultural, chemical and biological; principles and methods, integrated weed management, Implements for weed control, robotic weed control, weed management in organic/ natural farming.

Herbicide classification and properties of important herbicides, concept of adjuvants, surfactants, herbicide formulation and their use. 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

Practical: Techniques of weed preservation, Weed identification and losses caused by weeds. Biology of important weeds. Study weeds in different situations, Study on shift in weed flora in long term trials, Study of herbicide formulations and mixture of herbicide. Study methods of herbicide application, Herbicide spraying equipments, their parts, use and maintenance. Weed control implements, Calculation of herbicide doses and requirement, weed control efficiency and weed index.

Suggested readings:

- Crafts, A.S. and Robbins, W.W. 1973. Weed Control. Tata McGraw-Hill Publishing Co. Ltd., New Delhi.
Gupta, O.P. 1984. Scientific Weed Management. Today and Tomorrow Printers and Publishers, New Delhi.
Gupta, O.P. 2015. Modern Weed Management. Agro Bios (India), Jodhpur.
Naidu, V.S.G.R., Handbook of Weed Identification. Directorate of Weed Research, Jabalpur.
Rajagopal, A., Aravindan, R. and Shanmugavelu, K.G., 2015. Weed management of Horticultural Crops. Agro Bios (India), Jodhpur.
Ramamoorthy, K. and Subbian, P., Predominant Weed flora in hill –ecosystems. Agrobios (India), Jodhpur.
Rao, V.S. 2000. Principles of Weed Science. Oxford & IBH Publishing Co., New Delhi.
Subramanian, S., Mohammed Ali, A. and Jayakumar, R. 1991. All About Weed Control. Kalyani Publications, Ludhiana.
Tadulingam, C. and Venkatnarayana, D. 1955. A Handbook of Some South Indian Weeds. Government of Madras.
Thakur, C. 1977. Weed Science. Metropolitan Book Co. Pvt. Ltd., New Delhi.

Course Title :Ornamental Crops, MAPs and Landscaping

Credits Hours :3 (2+1)

Objectives:

1. To educate in detail about origin, area, climate, soil, improved varieties production technology of flowers and MAPs
2. To educate about concept, designing principles and components of landscaping
3. To educate about the physiological disorders of commercial flowers
4. To educate about the post-harvest management and value addition in flower crops and MAP

Theory:

Production technology of ashwagandha, costus, isabgol and geranium; Production technology of mint, aloe and ocimum; Production technology of plants like lemongrass, citronella, vetiver and palmarosa. Importance and scope of ornamental crops; Importance and scope of medicinal and aromatic plants and landscaping; Principles of landscaping; Landscape uses of trees, shrubs and climbers, Production technology of important cut flowers like rose, gerbera and orchids; Production technology of gladiolus, tuberose and lily; 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 in 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 plants by terminal/herbaceous cuttings; Propagation of Anthurium and orchids; Propagation of Bougainvillea; Planting of Gerbera suckers; Gladiolus corms; Establishment and maintenance of lawn; Preparation of flower preservatives and their use in extending the vase life of cut flowers; Training and pruning of ornamental plants and raising of hedge and edge; Planning and layout of garden.

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, Abdul Khadder, 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

Course Title : Introductory Agro forestry

Credits Hours : 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 conservation practices

Theory: Agro-forestry: Definition and scope of Agroforestry system, Type of Agroforestry system, potential of Agroforestry in India, Prevailing agroforestry system in NE India, MPTS- definition, role of MPTS in agroforestry system, its selection for different agroforestry system, MPTS of NE India, Ecological aspects of Agroforestry system, tree -crop interaction – competition, nutrient recycling, Traditional Agroforestry as a viable choice to conserve Agro biodiversity in North-East 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: Defination and scope of silviculture system, 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.

Practical: 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 students experience in vegetation, aforestation method, practical training, pruning, coppicing, pollarding etc. 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.

Suggested readings:

Nair, P.K.R : 1993. An Introduction to Agroforestry, Kluwer Academic Publisher

Semester VI

S. No	Course title	Total credits
1	Fundamentals of Agri Biotechnology	3(2+1)
2	Basic and Applied Agril. Statistics	3(2+1)
3	Crop Improvement - II	2(1+1)
4	Renewable energy in Agriculture and Allied Sector	2(1+1)
5	Dryland agriculture/ Rainfed agriculture and watershed management	2(1+1)
6	Agricultural Microbiology and Phyto-remediation	2(1+1)
7	Agricultural Finance & Cooperation	2(1+1)
8	Essentials of Plant Biochemistry	3 (2+1)
9	Fundamentals of Seed Science & Technology	2(1+1)
	Total	23(13+10)

Course Title : Fundamentals of Agricultural Biotechnology
Credits Hours : 3(2+1)

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

Theory:

Introduction to Plant Tissue Culture & Genetic Engineering: History; Cellular totipotency & cytodifferentiation; Callus culture, Single-cell/suspension culture and their applications, Organogenesis & somatic embryogenesis, Somaclonal variation and its use in crop improvement, Embryo rescue technique and its significance in hybrid development, In vitro fertilization, ovule culture and its significance in hybrid development, Protoplast isolation, culture and regeneration, Somatic hybridization (somatic hybrids & 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,

Introduction to Molecular Biology: DNA structure, structure & function; DNA replication, transcription and translation, RNA, types and function, Nucleic acid hybridization, PCR and its applications,

Introduction to recombinant DNA technology: DNA modifying enzymes & vectors, Plant genetic transformation – physical (Gene gun method), chemical (PEG mediated) and Agrobacterium-mediated gene transfer methods, Transgenics and its importance in crop improvement with successful stories,

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 & 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 & 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

Suggested readings:

Bhojwani SS. 1983. Plant Tissue Culture: Theory and Practice. Elsevier.

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Singh BD. 2007. Biotechnology: Expanding Horiozon. Kalyani

Christou P & Klee H. 2004. Handbook of Plant Biotechnology. John Wiley & Sons.

Lewin B. 2008. Gene IX. Peterson Publications/ Panima. W.H. Freeman & Co.

Primrose SB. 2001. Molecular Biotechnology. Panima.

Course Title : Basic and Applied Agril. Statistics

Credits Hours : 3(2+1)

Objectives: To provide an idea on Statistical concepts of both descriptive and inference Statistics which 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).

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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:

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

Course Title : Crop Improvement - II

Credits Hours : 2(1+1)

Objectives: i) To provide knowledge about Self-pollinated and crosspollinated Rabi crops

ii) To learn about origin and distribution of Rabi crops

iii) To design breeding objectives of major rabi crops

iv) 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 & Mustard etc. Ideotype concept, climate resilient crop varieties for future.

Practical:

Floral biology, emasculation and hybridization techniques in different crop species viz. Wheat, Oat, Rapeseed & 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 in tomato; 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

Course Title : Renewable energy in Agriculture and Allied Sector
Credits Hours : 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 student 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 in different places

Practical:

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

Suggested readings:

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

Course Title : Dryland agriculture/ Rainfed agriculture and watershed management
Credits Hours : 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; Soil and water conservation techniques, Drought: types, effect of water deficit on physiological and morphological characteristics of the plants, Crop adaptation and mitigation to drought; Water harvesting: importance and 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 adverse weather conditions, Concept, history, objective, principles and components of watershed management, factors affecting watershed management.

Practical: Studies on climate classification, studies on rainfall pattern in rainfed areas of the country and pattern of onset and withdrawal of monsoons. Studies on cropping pattern of different rainfed areas in the country. Demarcation of rainfed area on map of India. Interpretation of meteorological data and scheduling of supplementary irrigation on the basis of evapo-transpiration demand of crops. Critical analysis of rainfall and possible drought pattern in the country. Effective rainfall and its calculation. Studies on cultural practices for mitigating moisture stress, including mechanical and agronomic measures. Soil moisture determination under different land situations, Importance of seed priming to mitigate drought. Assessment of meteorological drought. Characterization and delineation of rainfed watershed. Field demonstration on soil & moisture conservation measures. Field demonstration on constructing 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 Publishing Agency, New Delhi.
2. D.Lenka, 2006. Climate, Weather and Crops in India. Kalyani Publishers, New Delhi.
3. G.S. L.H .V.Prasad Rao, 2008. Agricultural Meteorology. Prentice Hall of India Pvt. Ltd., New Delhi.
4. H.S.Mavi and Graeme J.Tupper, 2005. Agrometeorology – Principles and applications of climate studies in agriculture. International Book Publishing Co., Lucknow.
5. H.S.Mavi, 1994. Introduction to Agrometeorology. Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi.
6. H.V.Nanjappa and B.K.Ramachandrappa, 2007. Manual on Practical Agricultural Meteorology. Agricultural Science Publishers, India. Jodhpur.
7. S.R.Reddy, 1999. Principles of Agronomy. Kalyani Publishers, New Delhi.
8. T.Yellamanda Reddy and G.H.SankaraReddi, 2010. Principles Of Agronomy. Kalyani Publishers, New I

Course Title :Agricultural Microbiology and Bio -remediation
Credits Hours :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 phytoremediation
- 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: Plasmids, episomes, and genetically modified organisms
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

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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 equipments, 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. & Kreig, N.R. (2002) Microbiology. 5th Edition, Tata McGraw-Hill, New Delhi.
2. Rangaswami, G. & Bagyaraj, D. J. (2005) Agricultural Microbiology. Prentice-Hall of India Pvt. Ltd., New Delhi.
3. Mukherjee, N. & 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., & Whitt, D. D. (2001). Microbiology: diversity, disease, and the environment. Fitzgerald Science Press, Inc.
6. Prescott, L. M. (2002). Microbiology 5th Edition. McGraw-Hill Inc., US

Course Title : Agricultural Finance & Cooperation
Credits Hours : 2(1+1)

Objectives: 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: 4 R's, and 3C's of credits. Sources of agricultural finance: institutional and noninstitutional 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. 3 R's, 5 C's and 7 P's of credit. 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

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acquire firsthand 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:

Gittinger JP 1982. Economic Analysis of Agricultural Projects. The Johns Hopkins Univ. Press.

Reddy S. S and Ram P.R 1996. Agricultural Finance and Management. Oxford & IBH.

Course Title : **Fundamentals of Seed Science & Technology**
Credits Hours : **2(1 + 1)**

- s: i) To impart basic and fundamental knowledge on principles and practices seed science and technology
ii) To impart practical skills on scientific seed production and post harvest quality management. .

Theory: Introduction to seed technology, definition and importance. Seed quality -definition, characters of 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

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. New Delhi, India
2. Khare, D., Bhale, M.S. (2019). Seed Technology (2nd revised & enlarged edn), Scientific Publishers, ISBN: 978-81-72338-84-8, New Pali Road, P.O. Box 91, Jodhpur, India
3. Vanangamudi, K. (2014). Seed Technology (An illustrated book), New India Publishing Agency, New Delhi, India
4. Bhojwani SS & Bhatnagar SP. 1999. The Embryology of Angiosperm. Vikas Publ
5. McDonald MB Jr & Copeland LO. 1997. Seed Production: Principles and Practices. Chapman & Hall.
6. Tunwar NS & Singh SN. 1988. Indian Minimum Seed Certification Standards. CSCB, Ministry of Agriculture, New Delhi.

Semester VII

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

ELECTIVE COURSES

Sl. No	Title
1.	Agri-Business Management
2.	Management of natural resources
3.	Agrochemicals
4.	Agricultural Journalism
5.	Landscaping
6.	Commercial Plant breeding
7.	Food safety and standards
8.	Bioformulation and Nanoformulation
9.	Biopesticides and Biofertilizers
10.	System Simulation and Agroadvisory
11.	Hi-tech Horticulture
12.	Protected cultivation
13.	Climate Resilient Agriculture
14.	Biotechnology of Crop Improvement 3 (2+1)
15.	Geoinformatics and Remote Sensing, precision farming
16.	Micro-propagation Technologies
17.	Commercial Seed Production
18.	Principles and Practices of Organic Farming/ Conservation Agriculture
19.	Food Science and Nutrition
20.	Post Harvest Technology and Value Addition

- **More electives to be included by the universities / institutions, based on the facilities available such as nano fertilizers, drones use in agriculture etc**

Elective course 1

Course Title : Agri-Business Management

Credits Hours : 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 & SWOT analysis. Management functions: Roles & activities, Organization culture. Planning, meaning, definition, types of plans. Purpose or mission, goals or objectives, Strategies, policies procedures, rules, programs and budget. Components of a business plan, Steps in planning and implementation. Organization staffing, directing and motivation. Ordering, leading, supervision, communications, control. Capital management and Financial management of Agribusiness. Financial statements and their importance. Marketing Management: Segmentation, targeting & positioning. Marketing mix and marketing strategies. Consumer behavior analysis, Product Life Cycle(PLC). Sales & 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

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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 Management Theory And Practices:,Write And Print Publications
5. Virender Kamalvanshi , Agribisness Management:, Random.

Elective course 2

Course Title : Management of natural resources

Credits Hours : 4(3+1)

Objectives:

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

Theory: Introduction to Natural Resource Bases: Concept of resource, classification of natural resources. Factors influencing resource availability, distribution and uses. Interrelationships among different types of natural resources. Concern on Productivity issues. Ecological, social and economic dimension of resource management. Land resources: Land as a resource. Dry land, land use classification, land degradation, man induced landslides, soil erosion and desertification. Landscape impact analysis, wetland ecology & 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 utilityPracticing survey - Principles and educating to use pacing technique for measurement. Area calculations through chain survey - GPS demo for tracking and area measurement. Estimation of soil loss and calculation of erosion index.Leveling concepts and practical utility in agriculture. Preparation of contour maps.Concept of vegetative water ways and design of grassed water ways. Wind erosion and estimation process.Different irrigation pumps and their constructional differences. Farm pond construction and its design aspects. Visit to nearby farm pond. Visit to an erosion site. Exposure to strip cropping/contour bunding.

Suggested readings:

1. Sustainable Natural Resource Management by Danill R. Lynch
2. Management of Natural Resource for Sustainable Development, by Vijay Singh Rathor and B S Rathor , Daya Publishing House

3. Managing Natural Resources : Focus On Land And Water: Ed. Harikesh N. Mishra PHI, 2014 Learning, 496p.
4. Management of Resources for Sustainable Development: Sushma Goel, The Orient Blackswan 2016, 284p.
5. Natural Resources: Their Conservation and Management: Arvindrai Upadhyay, Aspiration Academy, 320p.
6. Natural Resource Management for Growth Development and Sustainability: Vasudeva Srishti Pal, 2023, Today & Tomorrows Printers And Publishers, 336p.

Elective course 3

Course Title : Agrochemicals

Credits Hours : 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 organochlorine, Organophosphates, Carbamates, Synthetic pyrethroids Neonicotinoids, Biorationals, Insecticide Act and rules, Insecticides banned, withdrawn and restricted use, fate of insecticides in soil & 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 in market. Estimation of nitrogen in Urea. Estimation of water soluble P_2O_5 and citrate soluble P_2O_5 in single super phosphate. Estimation of potassium in Muriate of Potash/ Sulphate of Potash by flame photometer. Determination of copper content in copper oxychloride. Determination of sulphur content in sulphur fungicide. Determination of thiram. Determination of ziram content

Suggested readings:

2. Buchel KH (Ed.) 1992. Chemistry of pesticides. John Wiley & Sons
3. Panda H. 2022. The Complete Technology Book on Pesticides, Insecticides, Fungicides and Herbicides (Agrochemicals) with Formulae, Manufacturing Process, Machinery & Equipment Details 2nd Revised Edition. NPCS
4. Biswas D. R. 2021. A Text Book of Fertilizers. New India Publishing Agency
2. Singh, A., 2022 Basics of Agrochemical Formulations:, Brillion Publishing, 176p.
3. Larramendy, M.L 2017 Toxicity and Hazard of Agrochemicals:, INTECH, 170p.

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Elective course 4

Course title: Agricultural Journalism

Credits Hours: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 stories-definition, nature, components, guidelines of writing a success story Writing a news story difference between news and feature story, the principle of writing a news story, Inverted pyramid structure. Organizing the material, treatment of the story, writing the news lead and the body Readability measure-readability ease score, automated readability index, gunning fog index How to improve readability of articles and stories. 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-Book by Carole Fleming, Emma Hemmingway, and Gillian Moore
2. Basic Journalism Book by Rangaswami Parthasarathy
3. News Reporting and Editing Book by K. M. Shrivastava
4. Professional Journalism Book by MV Kamath
5. The Journalist's Handbook Book by MV 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 5

Course Title :Landscaping

Credits Hours: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 landscaping design.

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 water garden, 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 used in landscape design, training and pruning of plants for special effects, lawn establishment and maintenance, layout of formal gardens, informal gardens, special type of gardens (sunken garden, terrace garden, rock garden) and designing of conservatory and lathe house. Use of computer software, visit to important gardens /parks /institutes.

Suggested readings:

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, New India Publishing Agency.
5. Landscape Gardening: Sudhir Pradhan, 2018, Scientific Publishers India.

Elective course 6

Course Title : Commercial Plant breeding
Credits Hours : 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 breeding in self and cross pollinated crops (A/B/R and two line system) for development of hybrids and seed production. Genetic test of commercial hybrids. Advances in hybrid seed production of maize, rice, sorghum, pearl millet, castor, sunflower, cotton pigeon pea, Brassica etc. Quality seed production of vegetable crops under open and protected environment. Alternative strategies for the development of the line cultivators: haploid inducer, tissue culture techniques and biotechnological tools. IPR issues in commercial plant breeding: DUS testing and registration of varieties under PPV & FR Act. Variety testing, release and notification systems in India. Principles and techniques of seed 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.

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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, PratibhaBisen, Reshu Tiwari. Daya Publishing House
2. Plant Breeding: Principles and Methods by B. D. Singh. Kalyani Publishers
3. Principles of Plant Breeding (1st & 2nd Edition) by RW Allard.
4. Breeding Field Crops by JM Poehlman.
5. Commercial Plant Breeding Objective: Phundan Singh, Mridula Billore and Monika Singh, 2021, Astral Publishing, 160p.
6. Breeding and Crop Production: H. Padmalatha, Random
7. Biotechnology for Agricultural Breeding: Mangal, S K, GeneTech Books

Elective course 7

Course Title : Food safety and standards

Credits Hours : 4(3+1)

Objectives:

6. To develop the skills to convert raw materials into safe, attractive food products
7. To manage the production of food products
8. 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 Hygiene. Food laws and Standards Indian Food Regulatory Regime, FSSAI. 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 readings:

- 1.Text book of Food Science and Technology by Avantina Sharma
2. Handbook of Food Safety: D.S.L. Khatekar and N. Sarkate, 2023, Step Up Academy, 576p.
3. Food And Beverage Management: Bernard Davis, Andrew Lockwood, Ioannis Pantelidis, Peter Alcott , 2011, Routledge
4. Food safety and Quality Control: Pulkit Mathur, 2018, The Orient Blackswan.332p.
5. Safe Food Handling: HACCP booklet for food handlers, Cletus Fernandes, Notion Press.

Elective course 8

Course Title : Bioformulation and Nanoformulation

Credits Hours :4(3+1)

Objectives:

1. To enable students to acquire expertise and skill to develop bioformulation and Nanoformulation
2. To know the importance of biopesticides and biofertilizers
3. To make the students know about various techniques involved in biofertilizers and biopesticides production
4. To get knowledge on essential oils, botanicals, predators, parasitoids, Pheromones, and parapheromone and their application in insect pest management
5. To get concepts on agrochemical formulations with nanoparticles and acquaint them with nanotechnology

Theory:

Introduction and history of biological control of pests and diseases, Microbial biopesticides: the global and Indian market scenario; biopesticides for organic agriculture, Different phytopathogenic biocontrol agents: Mode of action, Different entomopathogenic biocontrol agents: Mode of action, Microbial inoculants as biofertilizer candidates, Production, quality assessment and methods of application of biopesticides and biofertilizers, Regulatory system of biopesticides in India, Formulations of plant essential oils, botanicals, Pheromone, and parapheromone and their application in insect pest management, Use of predators and parasitoids for insect pest management, Nanotechnology: its applications in pest and disease diagnosis and management, Nano biopesticides: Concept and importance, different techniques of producing nano biopesticides, Nano Fertilizers: Concept and importance, Types of nano fertilizers, Different techniques of producing nano fertilizers, Green synthesis of nano fertilizers, green slow-release fertilizer composition based on urea-modified hydroxyapatite nanoparticles

Practical:

Introduction & acquaintance with biopesticide laboratory, Preparation of culture media, Isolation and purification of bioagent from soil and infected insects, Microscopic study of different microbial bioagents, In vitro assay of microbial bioagents against plant pathogens

In vitro compatibility study among different microbial bioagents, Mass multiplication of biopesticides, Population enumeration of biocontrol agents in different biopesticides, Preparation of plant extracts and their efficacy test against insect pests, Use of pheromone parapheromone for monitoring and management of insect pests, Bioassay of Entomopathogenic biocontrol agents on insect pests, Preparation of microbial inoculants of biofertilizer microbes, Compatibility of biofertilizer microbes, Preparation of solid & liquid consortia of biofertilizer microbes

Suggested readings:

1. Baker, E.F. and James, R.C. 1982. Biological Control of Plant Pathogens. American Phytopathological Society
2. Borkar, S.G. 2015. Beneficial Microbes as Biofertilizers and its Production Technology
3. Boland, G.J. and David, L. 1998. Plant microbe interactions and Biological Control. Kuykendall Marel Dekker, INC.
4. Ciancia, A. and Mukerji, K.J. 2007. General Concepts of Integrated Pest and Disease Management. Edited Published by Springer.
5. Cincholkar, S.B. and Mukherji, K.G. 2007. Biological Control of Plant Diseases. Hawarth Food and Agricultural products.
6. Gnanamanickam, S.S. 2002. Biological control of crop Disease. Kuykendall Marel Dekker, INC.
7. Ramanujam, B. and Rabindra, R.J. 2006. Current Status of Biological Control of Plant Disease using Antagonistic Organisms in India. Precision Fototype Services Bangalore.
8. Singh, S.P. and Hussanini, S.S. 1998. Biological Suppression of Plant Disease, Phytoparasitic Nematodes and Weeds. Precision Fototype Services Bangalore.
9. Allhoff, Fritz and Lin, Patrick (Eds) 2009. Nanotechnology and Society, ISBN: 978-1-4020- 6208-7 Springer Publications, UK

10. Prasad, Ram, Vivek Kumar, Manoj Kumar and Devendra Choudhary Eds, 2019. Nanobiotechnology in Bioformulations, Kindle Edition
11. Koul, Opendar Ed, 2019. Nano-biopesticides today and future perspectives, Academic Press
12. Shah, MA and Tokeer Ahmad Nano Science & Technology, Wiley India

Elective course 9

Course Title : Biopesticides and Biofertilizers

Credits Hours :4(3+1)

Objectives:

1. To provide knowledge on principles, methods, and mechanisms of bio-control agents and their use against plant diseases
2. To provide knowledge on principles, methods, and mechanism of biofertilizers and their use in agriculture

Theory

History and concept of bio pesticides. Importance, scope and potential of bio pesticides. Definitions, concepts and classification of bio pesticides viz. Pathogen, botanical pesticides, and bio rationales. Botanicals and their uses. Mass production technology of bio-pesticides. Virulence, pathogenicity and symptoms of entomopathogenic pathogens and nematodes, Methods of application of bio pesticides. Methods of quality control and Techniques of bio pesticides. Impediments and limitation in production and use of bio pesticides. Biofertilizers - Introduction, status and scope. Structure and characteristics features of bacterial biofertilizers – Azospirillum, Azotobacter, Bacillus, Pseudomonas, Rhizobium and Frankia; Cyanobacterial bio fertilizers- Anabaena, Nostoc, Hapalosiphon and fungal biofertilizers – AM mycorrhiza and ectomycorrhiza. Nitrogen fixation –Free living and symbiotic nitrogen fixation. Mechanism of phosphate solubilisation and phosphate mobilization, K solubilisation. Production Technology: Strain selection, sterilization, growth and fermentation, mass production of carrier based and liquid biofertilizers. FCO specifications and quality control of biofertilizers . Application technology for seeds, seedlings, tubers, sets etc. Biofertilizers-Storage, shelf life, quality control and marketing. Factors influencing the efficiency of biofertilizers.

Practical

Isolation and purification of important biopesticides: trichoderma Pseudomonas, Bacillus, Metarhizium etc. and its production. Identification of important botanicals. Visit to biopesticide laboratory in nearby area. Field visit to explore naturally infected cadavers. Identification of entomopathogenic entities in field condition. Quality control of biopesticides.

Isolation and purification of Azospirillum, Azotobacter, Rhizobium, P-solubilizers and cyanobacteria. Mass multiplication and inoculum production of biofertilizers. Isolation of AM fungi- Wet sieving method and sucrose gradient method. Mass production of AM inoculants.

Suggested readings:

Biopesticides

1. Baker, E.F. and James, R.C. 1982. Biological Control of Plant Pathogens. American Phytopathological Society
2. Boland, G.J. and David, L. 1998. Plant microbe interactions and Biological Control. Kuykendall Marel Dekker, INC.
3. Borkar, S.G. 2015. Beneficial Microbes as Biofertilizers and its Production Technology
4. Ciancia, A. and Mukerji, K.J. 2007. General Concepts of Integrated Pest and Disease Management. Edited Published by Springer.
5. Cincholkar, S.B. and Mukherji, K.G. 2007. Biological Control of Plant Diseases. Hawarth Food and Agricultural products.
6. Gnanamanickam, S.S. 2002. Biological control of crop Disease. Kuykendall Marel Dekker, INC.
7. Ramanujam, B. and Rabindra, R.J. 2006. Current Status of Biological Control of Plant Disease using Antagonistic Organisms in India. Precision Fototype Services Bangalore.
8. Singh, S.P. and Hussanini, S.S. 1998. Biological Suppression of Plant Disease, Phytoparasitic Nematodes and Weeds. Precision Fototype Services Bangalore.

Biofertilizers

1. Handbook of Microbial Biofertilizers- Dr. Awani Kr. Singh, Agrotech Press, Jaipur, India
2. Biofertilizers for Sustainable Agriculture- Sampat Nehra, Aavishkar Publishers, Jaipur, India
3. Organic Farming- A.K. Singh, New India Publishing Agency, New Delhi
4. Earthworm Vermiculture and Vermicomposting, R.K. Bhatnagar, R.K. Palta, Kalyani Publishers
5. Organic Farming: Standards, Accreditation, Certification and Inspection- Dushyent Gehlot, Agrobios (India)
6. Fungal Biopesticides and VAM applications-P.C.Trivedi, Pointer publishers, Jaipur, India

Elective course 10

Course Title : System Simulation and Agroadvisory

Credits Hours : 4(3+1)

Objectives:

1. To impart the knowledge of statistical and simulation modeling 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 & 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 modeling, techniques for their estimation. Crop production in moisture and nutrients limited conditions; components of soil water and nutrients balance. Weather forecasting, types methods, tools & 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 & achievable production; yield forecasting, insect & disease forecasting models. Simulation with limitations of water and nutrient management options. Sensitivity analysis of varying weather and crop management practices. Use of statistical approaches in data analysis and preparation of historical, past and present meteorological data for medium range weather forecast. Feedback from farmers about the agro advisory.

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. ICAR by MC Varshneya & PB Pillai
5. Principles of Agricultural Meteorology by OP Bishnoi

Elective course 11

[Type text]

Course Title :Hi-tech Horticulture

Credits Hours: 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 & importance; Nursery management and mechanization; micro propagation of 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 equipments 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), S. Prasad, Dharam Singh and R'L, Bharadwaj, 2020, Agrobios
4. Instant Horticulture, S.N.Gupta, Jain Brothers,2023, 488p.
5. Hydroponics for Beginners and Advanced: The Ultimate Hydroponic and Aquaponic Gardening Guide, Tom Garden, Webb Eleanor

Elective course 12

Course Title :Protected cultivation

Course code :Hort (ED) 413

Credits Hours : 3 (2+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 preparation and 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, lily, 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, SujanSinghPaikra, Manju Rani Sahu
3. Protected Cultivation of Horticulture Crops by Itigi Prabhakar, 2020, IBPSS.
4. Advances in Protected Cultivation byBrahma Singh and Balraj Singh, 2015, NIPA,252p.
5. Protected Cultivation and Smart Agriculture by Eds. Sagar Maitra, Dinkar J. Gaikwad and Tanmoy Shankar, 2020 New Delhi Publishers, 263p.
6. Textbook Of Protected Cultivation and Precision Farming For Horticultural Crops by B. Ashok Kumar, Eggadi Ramesh and Sindhu V, 2022, Jain Brothers.

Elective course 13

Course Title : Climate Resilient Agriculture

Credits Hours : 3(2+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 in agriculture

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 & climatic information, agro-advisories, ICTs and simulation models; climate resilient agronomic practices – crop/cultivar selection, crop diversification/ crop mixtures; water management practices – rain water harvesting, micro-irrigation, deficit irrigation and drainage management, 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, Wahid Hasan, Sachin G. Mundhe, Abdul Majid Ansari and Shivani Kumari, Biotech Books, 357p.
5. Climate Resilient Agriculture, Adaptation and Mitigation Strategies, Manish Bhan, 2018, New India Publishing Agency, 294p.
6. Climate Change & Agriculture Over India by Prasad Rao ,2010, PHI Learning, 352p.
7. Climate Smart Agriculture for Sustaining Crop Productivity and Improving Livelihood Security by Prakash M.2022, Satish Serial Publishing House, 178p..

Elective course 14

Course Title : Biotechnology of Crop Improvement 3 (2+1)

Credits Hours : 4(3+1)

Objectives:

1. To acquaint with biotechnological tools of crop improvement
2. To know about direct and indirect methods of gene transfer
3. To introduce about gene editing in plants
4. To provide knowledge about marker assisted breeding and genomic selection

Theory:

Impact of Biotechnology on crop improvement and the perspective of society; Various biotechnological techniques available for crop improvement – Plant Tissue Culture, Genetic Engineering, Genome editing, Marker Assisted breeding and Genomic Selection. Biosafety regulations and their application in Agricultural Biotechnology.

Somaclonal variation and its use in crop improvement; embryo culture; anther/pollen culture; somatic embryogenesis; artificial seeds; techniques of protoplast culture, regeneration and somatic cell hybridization, achievements and limitations, utility in the improvement of crop plants.

Direct and Indirect methods of gene transfer in plants - Agrobacterium-mediated gene transfer in dicots and monocots; DirectDNA delivery methods (microinjection, particle gun method, electroporation); gene targeting; Gene silencing techniques; introduction to siRNA; siRNA technology; Micro RNA; construction of siRNA vectors; principle and application of gene silencing; creation of transgenic plants; debate over GM crops; introduction to methods of genetic manipulation in different model systems.

Introduction to genome editing – Various tools of genome editing; CRISPR-Cas9 with specific emphasis on Indian regulations; Cloning genomic targets into CRISPR/Cas9 plasmids; electroporation of Cas9 plasmids into cells; purification of DNA from Cas9 treated cells and evaluation of Cas9 gene editing; in vitro synthesis of single guide RNA (sgRNA); using Cas9/sgRNA complexes to test for activity on DNA substrates; evaluate Cas9 activity by T7E1 assays and DNA sequence analysis; Applications of CRISPR/cas9 technology in crop plants.

Marker Assisted Breeding & Genomic Selection: Introduction to various DNA-based markers and their use in marker-assisted breeding; Foreground Selection, Recombinant Selection and background Selection; Marker-assisted backcross breeding, marker-assisted selection – success stories; Introduction to Genomic Selection.

Practical:

Agrobacterium-mediated transformation in Tobacco – preparation of construct, transfer to binary vector, transform Agrobacterium, prepare explant, Inoculation and Co-cultivation, antibiotic based selection of putative transformants, validation using PCR; Genome editing- preparation of CRISPR/Cas construct, direct transfer to plant, analysis of the targets; Planning of a MABB programme – selection of parents, crossing strategies, marker analysis

Suggested readings:

1. Old, R. W., Primrose, S. B., & Twyman, R. M. (2001). Principles of Gene Manipulation and Genomics, 7th Edition: Oxford: Blackwell Scientific Publications.

2. Green, M. R., & Sambrook, J. (2012). Molecular Cloning: a Laboratory Manual. Cold Spring Harbor, NY: Cold Spring Harbor Laboratory Press.
3. Brown, T. A. (2006). Genomes (3rd ed.). New York: Garland Science Pub.
4. Sander JD and Joung JK. (2014). CRISPR-Cas systems for Editing, Regulating and Targeting Genomes. Nat Biotechnol. 32:347-355.
5. Gene Cloning and DNA Analysis, 2010 Retrieved from <http://biolab.szu.edu.cn/otherweb/lzc/genetic%20engineering/courseware/b1.pdf>
6. Pranav Kumar and Usha Mina, 2015. Biotechnology: A Problem Approach, Pathfinder Publication,
7. K.H.Singh, Ajay Kumar and Nehanjali Parmar, 2019. Agricultural Biotechnology At a Glance:, science technology.
8. Hari Har Ram, 2019, Crop Breeding And Biotechnology: Kalyani Publications
9. S.C. Rastogi, 2020. Biotechnology: Principles and Applications, Narosa.
10. Slater, 2008. Plant Biotechnology: The Genetic Manipulation of Plants: Oxford, 400p.

Elective course 15

Course Title : Geoinformatics and Remote Sensing, precision farming

Credits Hours : 4(3+1)

General Objectives: Enabling students acquire knowledge on basics of remote sensing technique for precision farming applications

Specific Objectives: To provide a comprehensive knowledge of remote sensing, precision farming and its benefits in improving crop production and soil health management

Theory :

Introduction and history of remote sensing; sources, Principles of remote sensing; propagation of radiations in atmosphere; Interaction with matter, Applications of remote sensing

Land use soil surveys, crop stress and yield forecasting, Advantages and disadvantages of remote sensing; Remote sensing institutes in India, Basic Concepts about geoinformatics.

What is artificial intelligence; History of artificial intelligence, Fundamentals of big data & machine learning (ML), Use of artificial intelligence in autonomous systems: agricultural robots and drone monitoring systems, driverless tractors, automated sprinklers and self-harvesting machines etc.; Use of AI in crop analysis: monitoring soil quality, promoting organic crops, monitoring weeds, precision agriculture, using drones for crop analysis; Role of AI for sustainability and climate change, yield and demand forecasting, food tech/wider value chain including impact of blockchain, AI use for in the emerging markets; Technology deployment like sensors, AI and agricultural technologies and How to scale AI for agricultural technologies applications, Responsible AI in agriculture, Data sharing; Expert System: Introduction to expert system, Characteristics and features of expert system, Applications of Expert System, Importance of Expert system, Rule based system architecture; Software Agents.

Practical:

Familiarization with different remote sensing equipments and data products, Interpretation of aerial photographs and satellite data for mapping of land resources, Global positioning system (GPS), Basics of Geographic Information System (GIS), Georeferencing of toposheets,

Live examples and case study of AI use in Agriculture, Search and Control strategies: Blind search, Breadth - first search, Depth First search, Hill climbing method, Best First search, Branch and Bound search, Programming in Prolog Syntax and meaning of Prolog Programs. Using Data Structures. Controlling Back-tracking. Input and Output. Built-in Predicates, Using Prolog Grammar Rules. Higher level assignments/exercises for implementation using Prolog.

Suggested readings:

1. Data Analytics in Bioinformatics: A Machine Learning Perspective. Editor(s): Rabinarayan Satpathy, Tanupriya Choudhury, Suneeta Satpathy, Sachi Nandan .

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2. Machine Learning Approaches to Bioinformatics By Zheng Rong Yang
3. Text Book of Remote Sensing and Geographical Information Systems By M. Anji Reddy
4. Precision Agriculture Technologies for Food Security and Sustainability By A El-Kader, M Sherine, M El-Basioni, M Basma.
5. Principles and Theory of Geoinformatics P.K.Garg Khanna Publishers,2019, 296
6. Advances in Geoinformatics Remote Sensing and GIS by Bhunia, Gouri Sankar & Uday Chatterjee & Gopal Krishna Panda, BIO GREEN
7. Artificial Intelligence: Machine Learning, Deep Learning, and Automation Processes, John Adamssen,2020, Efalon Acies
8. Remote Sensing and Image Interpretation, 6ed (WSE) Paperback – 1 January 2011, Willey Student Edition
9. Remote Sensing and Geographic Information: A.M.Chandra and S.K.Ghosh, Narosa

Elective course 16

Course Title : Micro-propagation Technologies

Credits Hours : 4 (3+1)

Objectives: To educate the students in detail about the sterilization techniques for explants, preparation of 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 (callus and direct organ formation), Somatic embryogenesis, cell suspension cultures, production of secondary metabolites, Somaclonal variation, Cryopreservation.

Practical

Identification and use of equipments 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 K.L. Chadda
4. Plant Tissue Culture : Basic and Applied by Timir Baran Jha and Biswajit Ghosh, 2016, Platinum Publishers, 439p.

Elective course 17

Course Title : Commercial Seed Production

Credits Hours : 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 a class of Improved seeds, Reporting to Monitoring or certification Agency, Principles and practices of selection of area and agronomic requirement of seed production of field crops, Importance of isolation distance and 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 apomixis, male sterility and self incompatibility and its application in hybrid seed production of horticultural crops

General Principles of Seed Processing: Introduction, Objectives of Seed Processing, Seed Drying, Principles of Drying, Water vapour equilibrium, Methods of drying seeds, Cleaning and grading, Air and screen machines, Dimensional separators, Density separators, Surface texture separators, Colour separators, Spiral

separators, Electric separators, Vibrator separators, Separation based on Affinity to liquids, Seed treatment, Temperature treatment, Chemical treatment, Bagging and Labelling

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, Development of the vegetable and Flower seed industry, Seed marketing – concept, definition and purpose, importance and promotion of quality seed, formal and informal seed supply systems, Seed marketing intelligence and product mix, sales promotion, distribution channels, marketing costs and margins; packaging and labeling, 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

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 equipments; effect of drying temperature and duration on seed germination and storability seed processing equipments; seed treating equipments

Seed production in cross pollinated crops with special reference to land, isolation, Planting ratio of male and female lines, synchronization of parental lines and methods to achieve synchrony; supplementary pollination, pollen storage, hand emasculation and pollination in tomato, Hybrid seed production in Maize, detasseling in maize, identification of rogues and pollen shedders, Pollen collection, storage, viability and stigma receptivity; gametocide application and visits to seed production plots etc., Visit to seed processing plant and commercial controlled and uncontrolled Seed Stores, Seed industries and local entrepreneurs visit to nearby areas, Different methods of examination of seeds to assess seed-borne microorganisms and to quantify infection percentage, detection of seed borne fungi, bacteria and viruses, identification of storage fungi, control of seed borne diseases, seed treatment methods., Maintenance of aseptic conditions and sterilization techniques, Preparation of nutrient stocks for synthetic media, Selection of explants for callus induction, Preparation of MS medium for micro-propagation and Callus induction, Selection of explants for callus induction, Preparation of MS medium for micro-propagation and Callus induction, Inoculation of explants for micro-propagation, Inoculation of explants for callus induction and subsequently regeneration of plantlets from matured seeds of field and horticultural crops, Synthetic seed preparation

Suggested readings:

1. Agarwal RL. 1997. Seed Technology. 2nd Ed. Oxford & IBH.
2. McDonald MB Jr & Copeland LO. 1997. Seed Production: Principles and Practices. Chapman & Hall
3. Thompson JR. 1979. An Introduction to Seed Technology. Leonard Hill.
4. Singhal NC. 2003. Hybrid Seed Production in Field Crops. Kalyani.
5. Justice OL & Bass LN. 1978. Principles and Practices of Seed Storage. Castle House Publ. Ltd.
6. Tunwar NS & Singh SN. 1988. Indian Minimum Seed Certification Standards. CSCB, Ministry of Agriculture, New Delhi.
7. Chawla H.S. (2008) Introduction to Plant Biotechnology second edition, Oxford & IBH publishing Co. Ltd. 113-B Shahpur Jat, New Delhi-110049

Elective Course 18

Course Title : Principles and Practices of Organic Farming and Conservation Agriculture
Credits Hours : 2 (1+1)

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

Theory: Concept of organic farming, principles and its scope in India; Choice of crops and varieties in organic farming; Nutrient management in organic farming and their sources, Fundamentals of 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, .

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 ag Udaipur.
6. G.K.Veeresh. Organic farming. Foundation Books. New Delhi.
7. Purshit, S.S. Trends in Organic Farming in India. AgrosBios (INDIA), Jodhpur.
8. Thampan, P.K. Organic Agriculture. Peckaytree Crops Development Foundation, Cochin, Kerala.
9. Sathe, T.V. Vermiculture and Organic Farming. Days Publishing House, New Delhi.
10. Abhinandan Singh Pankaj Kumar Ojha & Rahul Kumar, 2018. Conservation Agriculture Technologies, Biotech Books
11. 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 19

[Type text]

Course Title : Food Science and Nutrition
Credits Hours : 4(3+1)

Objectives: To impart knowledge on the biochemical aspects of various nutrients and their interactions in foods during processing, storage and deterioration

Theory : Introduction on fundamentals of foods and human nutrition; Basic food groups; Concept of balanced diets; Recommended Daily Allowances (RDA) for various age groups; Biochemical composition, energy and food value of various food grains, fruits and vegetables; Carbohydrates, proteins, fats as nutrients and their interactions; Physio-chemical, functional and nutritional characteristics of essential nutrients- sources and functions, Nutritional requirements, malnutrition, inborn errors of metabolism, deficiency diseases; Digestion, absorption, transport and metabolism of nutrients in human system; Protein quality evaluation. Biochemical and nutritional aspects of vitamins, minerals, nutraceuticals, antioxidant, antinutritional factors and biochemistry of post harvest storage, losses during processing.

Effect of cooking, processing and preservation on nutrients of different food products, biochemical aspects of food spoilage; Food fads, food safety and quality standards.

Enzymes in food industry, food additives, nutritional quality of plant, animal, dairy, marine and fermented products.

Practical: Proximate analysis of foods; calorific value of foods, Estimation of vitamins, phenols & flavonoids, carotenoids, antinutrients like Phytate/ Oxallate, Trypsin and Chymotrypsin inhibitor activities, limiting amino acids in food stuff

Suggested readings:

1. Damodaran S. and Parkin KL (ed.) 2017. Fennema's Food Chemistry. CRC Press
2. Gibney MJ, Lanham-New SA, Cassidy, A and Voster HH (ed.) 2009. Introduction to Human Nutrition. Wiley-Blackwell
3. Trueman, P. 2007. Nutritional Biochemistry. MJP Publishers
4. Rekhi, Tejmeet and Heena Yadav, 2014. Fundamentals of Food and Nutrition by, Elite Publishing House, 257p.
5. Dharmesh Kumar, Food Science and Nutrition by, RANDOM.

Elective Course 20

Course Title : Post Harvest Technology and Value Addition
Credits Hours : 2 (1+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 of post harvest losses: Pre-harvest factors affecting postharvest 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, 2018, Bioscientific Publishers.
3. Postharvest Technology of Horticultural Crops by K.P. Sudheer and V. Indira, 2020, New India Publishing Agency, 320p.
4. Postharvest Management and Value Addition by Aswini Kumar Goel, Rajender Kumar and Satwinder S. Mann, 2014, Daya Publishing House.
5. Postharvest Management and Value Addition of Fruits and Vegetables by Kureel M.K., Biotech, 181p.

Semester VIII

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

SKILL ENHANCEMENT COURSE (SEC)

A student admitted into 1st year of B.Sc (Hons) Agriculture degree programme 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 basket of skill enhancement courses as indicated below 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 strength and expertise.

Indicative skill Enhancement courses:

Sl. No	Title	Credits
1.	Biofertilizer and biopesticide production	2(0+2)
2.	Production Technology of Bioagents	2(0+2)
3.	Seed Production and Testing Technology	2(0+2)
4.	Mushroom Production Technology	2(0+2)
5.	Soil, Plant and Water Testing	2(0+2)
6.	Post harvest processing technology	2(0+2)
7.	Beneficial insect farming	2(0+2)
8.	Plantation Crop Production and Processing	2(0+2)
9.	Poultry Production Technology	2(0+2)
10.	Piggery Production Technology	2(0+2)
11.	Commercial Horticulture	2(0+2)
12.	Floriculture and Landscaping	2(0+2)
13.	Food Processing	2(0+2)

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14.	Agriculture Waste Management	2(0+2)
15.	Organic Production Technology	2(0+2)
16.	Commercial Sericulture	2(0+2)
17.	Video Production	2(0+2)

ONLINE COURSES

The students will have to take a minimum of 10 credits of online courses (any one or more courses totaling at least 16 weeks or 30 hours' duration) as a partial requirement for the B.Sc (Hons) Agriculture

The online courses can be from any field such as Basic Sciences, Humanities, Commerce, Business Management, Languages including foreign language, Communication skills, Music, etc. and can be taken from SWAYAM, Diksha, NPTEL, moocKIT, 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-gradual 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.

ACKNOWLEDGEMENT

Acknowledgement is extended to the following teachers and administrators for their invaluable inputs in finalizing this report.

1. Dr. TejPartap, Chairman of the Sixth Deans' Committee and Former Vice-Chancellor, GBPUAT, Pant Nagar
2. Dr. Rakesh Chandra Agarwal, Deputy Director General, Agricultural Education and National Director, NAHEP, ICAR, KAB II, New Delhi
3. Dr.P. S. Pandey, Vice Chancellor, RPCAU, Pusa, Bihar and Former Assistant Director General [EP&HS], Education Division, ICAR, KAB-II, Pusa, New Delhi
4. Dr. S. K. Sankhyan, Former Member Secretary of the Sixth Deans' Committee & PS (EQR), Education Division, ICAR, KAB-II, Pusa, New Delhi
5. Dr. Ajit Singh Yadav, Assistant Director General (ADG), Education Quality Assurance and Reforms (EQAR), Agricultural Education Division, ICAR, KAB-II, Pusa, New Delhi
6. Dr. K. P. Tripathi, Principal Scientist, Agriculture Education Division, ICAR, KAB II, New Delhi
6. Dr. K. M. Bujarbaruah, Former Vice Chancellor, Assam Agricultural University, Jorhat
7. Dr. Bidyut Chandan Deka, Vice-Chancellor, Assam Agricultural University, Jorhat
8. All Deans of Faculty of Agriculture, SAUs and CAUs.
9. All Heads of Departments, Faculty of Agriculture, AAU, Jorhat.
10. All esteemed members of VI Deans' Committee, ICAR