Proceeding for the Board of Studies B.Sc. (Hons.) Agriculture/B.Sc. (Hons.) Horticulture Meeting of Sampoorna International Institute of Agri. Science and Horticultural Technology, affiliated to the University of Mysore (Situated at No. 271/2, K.B. Doddi, Gram Madapuri Doddi, Nidagatta Post, Nidagatta Gram Panchayath, Athkur Hobli, Maddur (Tq), Mandya (Dist.) was held on 17. 12. 2024 at 3 PM at DOS in Botany, Manasagangotri, UOM, Mysore 06.

MEMBERS PRESENT

NAME AND ADDRESSS	Designation	SIGNATURE
1) Prof. G.R. Janardhana, Dean, Faculty of Science and Technology University of Mysore, Mysore-570006	Chairman	
2) Dr. Sampoorna Naidu, Sampoorna Intl. Inst. of Agri. Sci. & Hortic. Tech. Maddur Tq. Mandya district	Member	
3) Dr.Padmashekar, Retd. V C, Sanskrit University, GoK, Ex Prof, UoM, Bangalore	Member	
4) Mrs. H.R.Prakash , Sampoorna Intl. Inst. of Agri. Sci. & Hortic. Tech. Maddur Tq, Mandya district	Member	
5) Mr. Chidvilas K.A.K, Sampoorna Intl. Inst. of Agri. Sci. & Hortic. Tech. Maddur Tq, Mandya dist.	Member	
6) The Dean, Sampoorna Intl. Inst. of Agri. Sci. & Hortic. Tech. Maddur Tq, Mandya district	Member	
MEMBERS ABSENT		
1) Dr. G. K Vasanth Kumar, Ex. Director, Additional Secretary to Dept. of Agriculture, GOK, Bangalore	Member	
2) Dr. G.N.Nagaraja, Sampoorna Intl. Inst. of Agri. Sci. & Hortic. Tech. Maddur Tq, Mandya district.	Member	

Minutes of the Meeting

1. **Changes if any in the existing syllabus/Scheme of examination of the degree program.**

   In continuation of the previous special BOS meeting held on 07.11.2024, the board has now prepared and approved the new and complete curriculum/syllabus for **B.Sc. (Hons.) Agriculture B.Sc. (Hons.) Horticulture** along with scheme of examinations as per the 6th Dean's Committee Recommendations of ICAR, Govt of India for its introduction from 2024-25.

2. **Preparation of Panel of Examiners for the academic year 2025-26.**

   The board unanimously prepared and approved the panel of examiners for the year 2025-2026 (Annexure-I & II)

3. **Any other subject with the permission of the Chairman.**
   -Nil-

(Prof. G.R. Janardhana)
CHAIRMAN, BOS
17/12/24

Chairman
BOS in Agriculture & Horticulture
University of Mysore
Mysore-570 006

UNIVERSITY OF MYSORE

REGULATIONS FOR UG PROGRAMMES
IN

B.Sc. (Hons.) Agriculture
and
B.Sc. (Hons.) Horticulture

UNDER SPECIALIZED PROGRAMME

Offered at

SAMPOORNA INTERNATIONAL INSTITUTE OF AGRI. SCIENCE AND HORTICULTURAL TECHNOLOGY

No. 271/2, K.B. Doddi, Gram Madapuri Doddi, Nidagatta Post
Nidagatta Gram Panchayath, Athkur Hobli, Maddur Taluk
Mandya District

2024-25

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Name	Designation	Signature
Dr. G.R.Janardhana Prof. DoS in Botany, Manasagangotri, Mysuru	Chairman	
Dr. Sampoorna Naidu B Vice Chairperson, SIIASHT	Member	
Dr. H.R.Prakash Asst. Director of Agriculture (Retd.) Professor, SIIASHT	Mem/ber	
Dr.Vasanth Kumar G.K Ex-Director & Additional secretary to Dept . of Agriculture GOK, Bangalore	Member	
Dr. G.N. Nagaraja Dean (Agri) (Retd) COA, UAS, GKVK Professor, SIIASHT	Member	
Mr.Chidvilas.K.A.K Agri. Entrepreneur	Member	
Dr. Padma Shekar Ex. Professor and Vice Chancellor UoM, Mysuru	Member	
Dean/Principal Member	Member	

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Mandya District

2024-25

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REGULATIONS

AND

CURRICULUM

UNIVERSITY OF MYSORE

CBCS and CAGP Regulations

1. TITLE–COMMENCEMENT

These Regulations shall be called the University of Mysore (UoM) regulations for Choice Based Credit System (CBCS) and Continuous Assessment Grading Pattern (CAGP) for B.Sc. (Hons.) Agriculture and B.Sc. (Hons.) Horticulture under the Specialized Programmes of UoM. These Regulations shall come into force from the academic year 2024-2025.

2. SPECIALIZED PROGRAMS

- B.Sc. (Hons.) Agriculture of four years—8 Semesters Majoring in Agriculture and Allied Science
- B.Sc. (Hons.) Horticulture of four years—8 Semesters Majoring in Horticulture and Allied Science

  (incorporated the 6th Dean Committee of ICAR Syllabus, Scheme and Curriculum)

Exit Option:

Provision for multiple exit and entry into the UG programme in Agriculture/Horticulture has been made. 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 / Horticulture and UG-Diploma in Agriculture / Horticulture respectively.

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

3. DEFINITION

Course: Every course offered will have two components associated with the teaching-learning process of the course, namely:

(i) Lecture – L (ii) Practical /Practice– P, where L stands for Lecture session. P stands for Practice session and it consists of Hands-on Experience / Laboratory Experiments / Field Studies / Case studies / Intensive Practice Exercises / Presentations / Discussions that equip students to acquire the much required Skill Component.

In terms of credits, every one-hour session of L amounts to 1 credit and a minimum of two hours' session of P amounts to 1 credit for teaching-learning process. The total duration of a semester is 21weeks.

A course shall have either one or both the components. That means a course may have only L component, or only P component or combinations of both.

The total credit earned by a student at the end of the semester upon successfully completing the

course is L+P. A course may be of 0+1, 1+0, 1+1, 2+0, 0+2, 2+2, 3+1, 3+2 upto 0+20 credits.

ELIGIBILITY FOR ADMISSION

A Candidate who is qualified as follows is eligible for admission:

- A candidate whoever has successfully completed +2 or equivalent with PCMB / PCB / CBZ combination.
- A candidate whoever has completed Diploma in Agriculture / Horticulture or equivalent of at least 2 years' duration after 10th year of schooling.
- A candidate whoever has successfully completed +2 or equivalent with PCM or other combinations is also eligible provided such a candidate completes the prescribed remedial courses in Biology during the 1st year of B.Sc. Honors program. The successful completion of remedial courses is mandatory and unless a candidate completes this mandatory requirement, he/she cannot enter 3rdsemester.
- A candidate whoever has completed inITI (whoever studied PCM) courses of a minimum of 2 years' duration subjected to 10 years of schooling are also eligible provided such a candidate completes the prescribed remedial courses in Biology during the 1st year of B.Sc. program. The successful completion of remedial courses is mandatory and unlessa candidate completes this mandatory requirement, he/she cannot enter into 3rd semester.
- A candidate whoever have successfully completed 1styear and 2nd year of B.Sc. Agricultural Science/Horticulture Science from UGC recognized Universities (within/outside a State) are eligible for admission to 2nd year and 3rd year of the course respectively subjected to the approval from the University of Mysore.
- The Universities may consider allowing lateral entry for the candidates having Diploma in Agriculture or Diploma from polytechnics in Technical / Engineering / Pathological / Clinical / Paramedical from UGC recognized Universities (within / outside Karnataka) with minimum 3 years course program after 10th or equivalent in related disciplines may be allowed admission into the 2nd year (3rd semester) of the UG programme as per the provisions and norms to be notified by the respective College / University from time to time.
- A candidate whoever completed UG certificate/UG Diploma in Agriculture or in Horticulture from UGC Recognised Universities within India is eligible for admission to 2nd year or 3rd year respectively within 3 Academic Years from the date of exit of their respective UG certificate/UG Diploma in Agriculture or in Horticulture subjected to the approval from the University of Mysore.

The intake shall be as approved by the University of Mysore from time to time.

4. SCHEME OF INSTRUCTION

5.1 The B.Sc. (Hons.) Agriculture / B.Sc. (Hons.) Horticulture degree program is of 8 semesters - 4 years' duration of 167+10*(*NC-MOOC) = 177 credits.

5.2 The first year of the course program comprises Skill Development Courses along with other fundamental courses of Agricultural/ Horticultural 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 or Horticulture respectively on exit. The students continuing the study further, would not have to attend the internship after 1st year.

5.3 The second year has been designed with the Skill Development Courses, basic courses as well as fundamental courses in Agriculture or Horticulture with adequate theory and practical components, enabling the student to get acquainted with the basic principles and applications of Agricultural Sciences or Horticutural Science. After satisfactory completion of the courses (84 credits) during first two years and subsequent satisfactory completion of 10 credits (10weeks) of internship, the student will become eligible for the award of UG-Diploma in Agriculture or Horticulture respectively on exit. The students continuing the study further would not have to attend the internship after 2nd year.

5.4 During the 5th semester, the students will have a study tour of 10-12 days' duration, which will be counted as 2 credits (Non-gradial). The third-and fourth year courses have been designed to impart specialized knowledge to the students in the major disciplines.

5.5 The students will have to complete a minimum of 10 credits of online courses during four years (preferably during 3rd and 4th year) as a partial requirement of the B.Sc. (Hons.) Agriculture/ B.Sc. (Hons.) Horticulture program. Online courses can be from any field such as Agriculture and allied sciences, Basic Sciences, Humanities, Psychology, Anthropology, Economics, Business Management, Languages including Foreign Languages, Communication skills / Music, etc. and can be taken from NPTEL, Mook IT, edX, Coursera, SWAYAM or any other such reputed portal.

5.6 These online courses will be non-gradial 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 indicate 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/Principal of the College for a permission and records (For 10 credits of online courses, the students should attend 130-135 contact hours).

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

5.8 Students may be permitted to take a break from the study during the period of study but the total duration for completing the degree programme of the B.Sc. (Hons.) Agriculture/ B.Sc. (Hons.) Horticulture shall not exceed 7 years.

5.9 A Candidate can exericise an option to exit with B.Sc. degree by completing 127 credits as stipulated in the corresponding first six semesters of the B.Sc. (Hons.) Agriculture/ B.Sc. (Hons.) Horticulture.

5.10 A candidate shall enroll for a minimum of 20 credits and a maximum of 28 credits per semester. However minimum/maximum course load may have exempted by the Dean when the students has only a few courses to complete. In addition, the students can be permitted to register a maximum of extra 13 credits as supplementatry course credits. However, the total credit including supplementary course credits shall not exceed a maximum of 41 credits.

5.11 A supplementary course credits shall be registered along with the regular courses at the time of registration.

5.12 Post Final year UG students may register the courses along with 1st, 2nd,3rd or 4th year students or in combination with any of these batches. However total number of the credits should not exceed 28 in a semester.

5.13 Candidates who register for a minimum credit per semester and complete successfully 177 credits in 8 successive semesters shall be considered for declaration of ranks and medals.

5.14 A candidate has to earn 177 credits for successful completion of B.Sc. (Hons.) Agriculture/ B.Sc. (Hons.) Horticulture degree program with the distribution of credits for different semeters as given in the tables.

6. 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.

Courses	Internal includes progressive assessment with quiz / Presentation/Seminar/ Review Tests		External Theory/ Practical
	IA = C1 + C2 Theory & Practical	IA = C1 + C2 Theory/ Practical	
For Courses having both Theory and Practical Integrated Components	50 %	-	50 %
For courses with theory only	-	50 %	50 %
Courses with practical only	-	50%	50 %

6.1 Assessement and Evaluation processes happen in a continuous mode. However, for reporting purpose a semester is divided into three discrete components identified as C1, C2 and C3.

6.2 Performance of the candidate in a course will be assessed for a maximum of 100 marks as explained below

6.2.1 The first component (C1) of assessment is for 25 marks. This will be based on the Review Tests, Assignment/Prsentation/Quiz etc., during the 1st half of the semester after the completion of 50% of the syllabus for both Theory and Practical (L+P courses), for 50% Theory syllabus (L-courses) and for 50% Practical syllabus (P-courses). This shall be completed during the 9th to 10th week of the semester.

6.2.2 The Second component (C2) of assessment is for 25 marks. This will be based on the Review Tests, Assignment/Prsentation/Quiz etc., during the 2st half of the semester after the completion of remaining 50% of the syllabus for both Theory and Practical (L+P courses), for 50% Theory syllabus (L-courses) and for 50% Practical syllabus (P-courses). This shall be completed during the 18th to 19th week of the semester.

6.2.3 During the 19th to 21st week of the semester, a semester end examination of 2 to 2.5 hours' duration shall be conducted for each course. This forms the Third/Final component of assessement C3. The maximum marks for final component will be 50.

6.2.4 The Evaluation pattern for Students READY Program as follows

6.2.4.1 RAWE Program EVALUTION PATTERN

Sl. No.	CRITERIA	MARKS
1.	Initiation, Creativity & Diligence	15
2.	General Conduct & Discipline	10
3.	Work Experience and Examination	50
4.	Presentation, Group Discussion and Evaluation of Reports	25
TOTAL		**100**

6.2.4.2 Inplant Training/Internship Program EVALUTION PATTERN

Sl. No.	PARTICULARS	MARKS
1.	Work Diary	20
2.	Training/Internship Performance	20
3.	Work Presentation	05
4.	Group Discussion / Viva	10
5.	Work Report	20
6.	Examination	25
TOTAL		**100**

6.2.4.3 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.

6.2.5 The Online/MOOC Courses after successfull completion by the student will be indicated in the transcript with 'Satisfactory' remark.

6.2.6 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.

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

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

$$\text{CGPA} = \sum \frac{(\text{Grade point X credit Hours}) \text{ until last semester}}{\text{Total credit hours until last semester}}$$

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.

AWARD OF DIVISIONS:

To qualify for the UG certificate, UG diploma and UG degree, a student shall complete all the prescribed courses with an overall grade point average OGPA of not less than 5.000 out of 10.000

The award of the divisions will be as follows

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

6.2.7 CONTINUOUS ASSESSMENT EARNING OF CREDITS ANDAWARD OF GRADES

The evaluation of the candidate shall be based on continuous assessment. The structure for evaluation is as follows:

6.2.8 SETTING QUESTION PAPERS AND EVALUATION OF ANSWER SCRIPTS.

I. Question papers (for C3) in three sets shall be set by the internal examiner for a course. Whenever there are no sufficient internal-examiners, the chairman of BoE shall get the question papers set by external examiners.

II. The Board of Examiners shall scrutinize and approve the question papers and scheme of valuation.

III. i) There shall be single valuation for all theory papers by internal examiners.

(ii) The examination for Practical work/Field work/Project work/Internship will-be conducted jointly by internal and external examiners. However, the BoE on its discretioncan also permit two internal examiners.

IV. CHALLENGE VALUATION

A student who desires to apply for challenge valuation shall obtain a photo copy of the answer script by paying the prescribed fee within 10 days after the announcement of the results. He / She can challenge the grade awarded to him/her by surrendering the grade card and by submitting an application along with the prescribed fee to the Registrar (Evaluation) within 15 days after the announcement of the results. This challeng evaluation is only for C3 component.

The answer scripts for which challeng evaluation is sought for shall be sent to another examiner. The higher of two marks from first valuation and challenge value shall be the final. In case of a course with only practical component a practical examination will be conducted with both internal and external examiners. A candidate will be assessed on the basis of

a) Knowledge of relevant processes
b) Skills and operations involved
c) Results / products including calculation and reporting.

If external examiner does not turn up, then both the examiners will be internal examiners.

6.2.9 If X is the marks scored by the candidate out of 50 in C3 in theory examination, if Y is the marks scored by the candidate out of 50 in C3 in Practical examination, and then the final marks M in C3 is decided as per the following table:

L+P distribution	Final mark M in C3
L+P	$\frac{(L*X)+(P*Y)}{L+P}$
L+(P=0)	X
(L=0) +P	Y

6.2.10 THE DETAILS OF CONTINUOUS ASSESSMENT ARE SUMMARIZED BELOW

Component	Syllabus in a course	Weightage	Period of Continuou assessment
C1	First 50% (first 2 units of total 4 units)	25% (courses with Theory & Practical) or 25% (courses with Theory only) or 25% (courses with Practical only)	First half of the semester to be consolidated by 9th week
C2	Remaining 50% (remaining units of the course)	25% (courses with Theory & Practical) or 25% (courses with Theory only) or 25% (courses with Practical only)	Second half of the semester to be consolidated by 19th week
C3	Semester-end examination (all units of the course)	50% (For final Theory & Practical) or 50% (courses withTheory only) or 50% (courses with Practical only)	To be completed during 19th - 21st week

Final grades to be announced latest by 24th week

A candidate's performance from all 3 components will be in terms of scores, and the sum of all three scores will be for a maximum of 100 marks (25+25+ 50). Finally, awarding the grades should be completed latest by 24th week of the semester.

6.3 EVALUATION OF PROJECT / THESIS/ DISSERTATION/ INTERNSHIP

Right from the initial stage of defining the problem, the candidate has to submit the progress reports periodically and also present his/her progress in the form of seminars in addition to the regular discussion with the guide. Components of evaluation are as follows:

Component – I (C1): Periodic Progress and Progress Reports (25%) Component– II (C2): Results of Work and Draft Report (25%) Component– III(C3): Final Viva-voce and evaluation (50%).The report evaluationis for 30% and the Viva-voce examination is for 20%

6.4 In case a candidate secures less than 30% in C1and C2 put together in a course, the candidate is said to have DROPPED that course, and such a candidate is not allowed to appear for C3 in that course.

6.5 In case a candidate's class attendance in a course is less than 80% or as stipulated by the University, the candidate is said to have **DROPPED** that course, and such a candidate is not allowed to appear for C3 in that course.

6.6 In case a candidate secures more than 30% in C1+C2 but less than 30% in C3, such a candidate may opt to DROP that course or may opt to appear for C3 examination during the subsequent examinations. In case he/she opts to appear for just C3 examination, then the marks scored in C1+C2 shall get continued. Repeat C3 examinations will be conducted in every semester.

6.7 A candidate has to re-register for the DROPPED course when the course is offered again by the department. A candidate who is said to have DROPPED project or internshipwork has to re-register for the same subsequently within the stipulated period. The details of any DROPPED course will not appear int he grades card.

6.8 The tentative / provisional grade card will be issued by the Registrar (Evaluation) at the end of every semester indicating the courses completed successfully. This statement will not contain the list of DROPPED courses.

6.9 Upon successful completion of B.Sc. Honors Degree, a final grade card consisting ofgrades of all courses successfully completed by the candidate will be issued by the Registrar (Evaluation).

7. PROVISION FOR APPEAL

If a candidate is not satisfied with the evaluation of C1 and C2 components, he/she can approach the grievance cell with the written submission together with all facts, the assignments, and test papers etc., which were evaluated. He/she can do so before the commencement of semester-end examination. The grievance cell is empowered to revise the marks if the case is genuine and is also empowered to levy penalty as prescribed by the university on the candidate if his/her submission is found to be baseless and unduly motivated. This cell may recommend taking disciplinary/corrective action on an evaluator if he/she is found guilty. The decision taken by the grievance cell is final.

For every program there will be one grievance cell. The composition of the grievance cell is as follows.

The Registrar (Evaluation) ex-officio Chairman/ Convener

One senior faculty member (other than those concerned with the evaluation of the course concerned) drawn from the department/discipline and/or from the sisterdepartments/sister disciplines. One senior faculty member/subject expert drawn from outside the University department

Semester wise Allocation of courses for

B.Sc. (Hons.) Agriculture Degree Programme

I Semester curriculum

Sem	Sl No.	Course Title	Course Code	L+P	Credit hrs.	Credit
I	1	Farming based lively hood systems	SAGR 111	2+1	4	3
	2	Fundamentals of Agronomy	SAGR 112	2+1	4	3
	3	Fundamentals of Soil Science	SSAC 111	2+1	3	3
	4	Fundamentals of Horticulture	SHRT 111	2+1	4	3
	5	Rural Sociology and Educational Psychology	SAEX 111	2+0	2	2
	6	Communication Skills	SENG 111	1+1	2	2
	7	Bio-fertilizer and Bio-pesticide production	SECA 111	0+2	4	2
	8	Mushroom Production Technology	SECA 112	0+2	4	2
	9	National Service Scheme (NSS-I)	SNSS 111	0+1	2	1
	10	Deeksharambh	SDAR 111	0+2 (NG)	4	2
	11	Kannada-1	SKAN 111	1+0 (NG)	2	1
	12	Introductory mathematics	SMAT 111	1+0 (NG)	1	1
		TOTAL		11+10	36	21

II Semester curriculum

Sem	Sl No.	Course Title	Course Code	L+P	Credit hrs.	Credit
II	1	Soil Fertility Management	SSAC 122	2+1	4	3
	2	Fundamentals of Entomology	SENT 121	2+1	4	3
	3	Fundamentals of Plant Pathology	SPAT 121	2+1	4	3
	4	Personality Development	SAEX 122	1+1	3	2
	5	Environmental Studies and Disaster Management	SAMT 121	2+1	4	3
	6	Livestock and Poultry Management	SASC 121	1+1	3	2
	7	Seed Production and Testing Technology	SECA 123	0+2	4	2
	8	Post harvest processing technology	SECA 124	0+2	4	2
	9	NCC-II/NSS-II	SNSS 122	0+1	2	1
		TOTAL		10+11	32	21

III Semester curriculum

Sem	Sl No.	Course Title	Course Code	L+P	Credit hrs.	Credit
III	1	Principles and Practices of Natural Farming	SAGR 214	1+1	3	2
	2	Crop Production Technology-I(*Kharif* crops)	SAGR 213	1+2	5	3
	3	Production Technology of Fruit and Plantation Crops	SHRT 212	1+1	3	2
	4	Principles of Genetics	SGPB 211	2+1	4	3
	5	Entrepreneurship Development and Business Communication	SAEX 214	2+1	4	3
	6	Fundamentals of Extension Education	SAEX 213	1+1	3	2
	7	Fundamentals of Nematology	SENT 212	1+1	3	2
	8	Beneficial insect farming	SECA 215	0+2	4	2
	9	Physical Education, First Aid, Yoga Practices and Meditation	SPED 211	0+2	4	2
		TOTAL		09 +12	33	21

IV Semester curriculum

Sem	Sl No.	Course Title	Course Code	L+P	Credit hrs.	Credit
IV	1	Crop Production Technology-II (*Rabi* Crops)	SAGR 225	1+2	5	3
	2	Water Management	SAGR 226	1+1	3	2
	3	Problematic Soils and their management	SSAC 223	1+1	3	2
	4	Production Technology of Vegetables and Spices	SHRT 223	1+1	3	2
	5	Basics of Plant Breeding	SGPB 222	2+1	4	3
	6	Principles of Agricultural Economics and Farm Management	SAEC 221	2+0	2	2
	7	Farm Machinery and Power	SAEG 222	1+1	3	2
	8	Agricultural Informatics and Artificial Intelligence	SAEG 221	2+1	4	3
	9	Horticulture nursery management	SECA 226	0+2	4	2
		TOTAL		11+10	31	21

V Semester curriculum

Sem	Sl No.	Course Title	Course Code	L+P	Credit hrs.	Credit
V	1	Introduction to Agro-meteorology	SAMT 312	1+1	3	2
	2	Weed Management	SAGR 317	1+1	3	2
	3	Ornamental Crops, MAPs and Landscaping	SHRT 314	1+1	3	2
	4	Introductory Agroforestry	SAGR 318	1+1	3	2
	5	Pest management in Crops and Stored Grains	SENT 313	2+1	4	3
	6	Diseases of Field & Horticultural Crops & their Management	SPAT 312	2+1	4	3
	7	Agricultural Marketing and Trade	SAEC 312	2+1	4	3
	8	Crop Improvement (*kharif* crops)–I	SGPB 313	1+1	3	2
	9	Fundamentals of Crop Physiology	SCPH 311	2+1	4	3
		TOTAL		13+9	31	22

VI Semester curriculum

Sem	Sl No.	Course Title	Course Code	L+P	Credit hrs.	Credit
VI	1	Dry land agriculture/Rainfed agriculture and watershed management	SAGR 329	1+1	3	2
	2	Agricultural Finance & Cooperation	SAEC 323	1+1	3	2
	3	Crop Improvement (*Rabi* crops)– II	SGPB 324	1+1	3	2
	4	Basic and Applied Agril Statistics	SAST 321	2+1	4	3
	5	Fundamentals of Seed Science & Technology	SSST 321	1+1	3	2
	6	Renewable energy in Agriculture and Allied Sector	SAEG 323	1+1	3	2
	7	Fundamentals of Agri Biotechnology	SABT 321	2+1	4	3
	8	Agricultural Microbiology and Phyto-remediation	SPAT 323	1+1	3	2
	9	Essentials of Plant Biochemistry	SBCH 321	2+1	4	3
		TOTAL		12+9	30	21

VII Semester curriculum

Sem	Sl No.	Course Title	Course Code	L+P	Credit hrs.	Credit
VII	**Any of the following Five Elective Courses each of 4 (3+1) credits / Research projects**					
	1.	Agri-Business Management	SAEC 415	3+1	5	4
	2.	Agricultural Journalism	SAEX 414	3+1	5	4
	3.	Climate Resilient Agriculture	SAGR 411	3+1	5	4
	4.	Principles and Practices of Organic Farming / Conservation Agriculture	SAGR 412	3+1	5	4
	5.	Commercial Plant Breeding	SGPB 415	3+1	5	4
	6.	Biotechnology of crop Improvement	SABT 412	3+1	5	4
	7.	Commercial Sericulture	SENT 414	3+1	5	4
	8.	Land scaping	SHRT 415	3+1	5	4
	9.	Hi-Tech Horticulture	SHRT 416	3+1	5	4
	10.	Protected cultivation	SHRT 417	3+1	5	4
	11.	Post Harvest Technology and Value Addition	SGRT 418	3+1	5	4
	12.	Commercial Seed Production	SSST 412	3+1	5	4
	13.	Micro-propagation Technologies	SCPH 412	3+1	5	4
	14.	Bioformulation and Nano formulations	SCPH 413	3+1	5	4
	15.	Food Science and Nutrition	SHRT 419	3+1	5	4
	16.	Geo informatics and Remote Sensing, precision farming	SAEG 414	3+1	5	4
		TOTAL= 20				

VIII Semester curriculum

Sem	Sl No.	Course Title	Course Code	L+P	Credit hrs.	Credit
VIII	**1**	Student READY :RAWE/ Industrial Attachment /Experiential Learning / Hands-on Training/ Project Work / Internship	SSRA 421	**0+20**	**40**	**20**
			Total			**167**
	2	***Online courses**			**10**	**10**
			Grand Total			**167 + 10***

TOTALCREDITS:

Semester	Credits
I	21
II	21
III	21
IV	21
V	22
VI	21
VII	20
VIII	20
TOTAL	**167**
Online courses	**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(11+11)**
2	Farming based livelihood systems	3(2+1)	
3	Crop Production Technology-I (*Kharif* Crops)	3(1+2)	
4	Crop Production Technology-II (*Rabi* Crops)	3(1+2)	
5	Water Management	2(1+1)	
6	Weed Management	2(1+1)	
7	Introductory Agroforestry	2(1+1)	
8	Dry land 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)	
3	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 (*Kharif* crops)–I	2(1+1)	
4.	Crop Improvement (*Rabi* crops)- II	2(1+1)	
5.	Fundamentals of Seed Science and Technology	2(1+1)	
	Entomology		
1.	Fundamentals of Entomology	3(2+1)	**8(5+3)**
2.	Pest management in Crops and Stored Grains	3(2+1)	
3.	Fundamentals of Nematology	2(1+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)	**11(7+4)**
2.	Fundamentals of Extension Education	2(1+1)	
3.	Communication skills	2(1+1)	
4.	Personality development	2(1+1)	
5.	Entrepreneurship Development and Business Communication	3(2+1)	
Agricultural Meteorology			
1.	Environmental Studies and Disaster management.	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)	**6(4+2)**
2.	Agricultural Marketing and Trade	2(1+1)	
3.	Agricultural Finance & Cooperation	2(1+1)	
Agricultural Statistics			**6(4+2)**
1.	Basic and Applied Agril Statistics	3(2+1)	
2.	Introductory Mathematics (Non gradial)	1(1+0)	
Agricultural Engineering			
1.	Farm Machinery and Power	2(1+1)	
2.	Renewable energy in Agriculture and Allied Sector	2(1+1)	**7(4+3)**
3.	Agricultural Informatics and Artificial Intelligence	3(2+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)**
3.	Physical Education, First Aid and Yoga Practices	2(0+2)	**2(0+2)**
4.	Study Tour	2(0+2)	**2(0+2)** Non gradial
***Elective Courses(Indicative)**			
1	Agri-Business Management	4(2+2)	
2	Management of natural resources	4(2+2)	
3	Agrochemicals	4(2+2)	
4	Agricultural Journalism	4(2+2)	
5	Landscaping	4(2+2)	
6	Commercial Plant breeding	4(2+2)	
7	Food safety and standards	4(2+2)	

8	Bioformulation and Nanoformulation	4(2+2)	**20*(10+10)** 5* Elective Courses
9	Biopesticides and Biofertilizers	4(2+2)	
10	System Simulation and Agro advisory	4(2+2)	
11	Hi-tech Horticulture	4(2+2)	
12	Protected cultivation	4(2+2)	
13	Climate Resilient Agriculture	4(2+2)	
14	Biotechnology of Crop Improvement	4(2+2)	
15	Geoinformatics and Remote Sensing, precision farming	4(2+2)	
16	Micro-propagation Technologies	4(2+2)	
17	Commercial Seed Production	4(2+2)	
18	Principles and Practices of Organic Farming/Conservation Agriculture	4(2+2)	
19	Food Science and Nutrition	4(2+2)	
20	Post-Harvest Technology and Value Addition	4(2+2)	

Skill enhancement courses (SECs)

1.	SDC-I (Bio-fertilizer and biopesticide production)	2(0+2)	**12(0+12)**
2.	SEC-II (Mushroom production technology)	2(0+2)	
3.	SEC-III (Seed Production Technology)	2(0+2)	
4.	SEC-IV (Post harvest processing technology)	2(0+2)	
5.	SEC-V (Beneficial insect farming)	2(0+2)	
6.	SEC-VI (Horticulture nursery management)	2(0+2)	

Semester-wise Allocation of courses for

B.Sc.(Hons.) Horticulture Degree Programme

I Year I Semester

Sem	Sl. No	CourseTitle	CourseCode	L+P	Credit hrs.	Credit
I	1	Fundamentals of Horticulture	SHRT.111	(2+1)	4	3
	2	Plant Propagation and Nursery Management of Fruit and Plantation crops	SHRT.112	(1+2)	4	3
	3	Commercial production of Flower crops	SFLA.111	(1+2)	4	3
	4	Farming Based Livelihood Systems	SAGR.111	(2+1)	4	3
	5	Sprinkler and Micro irrigation systems	SHAG.111	(1+1)	3	2
	6	Communication Skills	SENG.111	(1+1)	3	2
	7	Apiculture	SECH.111	(0+2)	4	2
	8	Mushroom Cultivation	SECH.112	(0+2)	**4**	**2**
	9	NCC-I/NSS-I	SNSS.111	(0+1)	2	1
	10	Deeksharambh	SDAR.111	(0+2) NG Non-gradial	4	2
TOTAL				**8+15**	**33+4**	**23**

I Year II Semester

Sem	Sl.No	CourseTitle	Course Code	L+P	Credit hrs.	Credit
II	1	Introduction to Major Field crops	SAGR.122	(2+1)	4	3
	2	Commercial Production of Spices and Plantation crops	SPMS.121	(2+1)	4	3
	3	Plant Propagation and Nursery Management in Vegetables, Flowers and Medicinal crops	SHRT.123	(1+2)	5	3
	4	Personality Development	SHEX.122	(1+1)	3	2
	5	Entrepreneurship Development and Business Management	SHEC.211	(2+1)	4	3
	6	Environmental Studies and Disaster Management	SAMT.121	(2+1)	4	3
	7	Orchard Floor Management	SECH.123	(0+2)	4	2
	8	Landscape Gardening	SECH.124	(0+2)	4	2
	9	NCC-II/NSS-II	SNSS.121	(0+1)	2	1
TOTAL				**10+12**	**34 + 4**	**22**

II Year III Semester

Sem	Sl. No	CourseTitle	Course Code	L+P	Credit hrs.	Credit
III	1	Fundamentals of Soil Science	SSAC.211	(2+1)	4	3
	2	Commercial Fruit Production	SFSC.211	(3+1)	5	4
	3	Precision Farming and Protected Cultivation	SHRT.214	(2+1)	4	3
	4	Seed Production of Vegetable, Tuber and Spice crops	SHRT.215	(2+1)	4	3
	5	Disease Management of Horticulture crops	SPAT.211	(2+1)	4	3
	6	Physical Education, First Aid, Yoga Practices and Meditation	SPED.211	(0+2)	4	2
	7	Post Harvest Management of Horticultural Produce	SECH.125	(0+2)	4	2
TOTAL				**11+9**	**29**	**20**

II Year IV Semester

Sem	Sl.No	CourseTitle	CourseCode	L+P	Credit hrs.	Credit
IV	1	Commercial Vegetable Production	SVSC.221	(3+1)	5	4
	2	Farm Power and Machinery for Horticulture	SHEG.222	(2+1)	4	3
	3	Agricultural Informatics and Artificial Intelligence	SHEG.223	(2+1)	4	3
	4	Urban and Peri Urban Horticulture	SHRT.226	(1+1)	3	2
	5	Agriculture Marketing and Trade	SHEC.312	(2+1)	4	3
	6	Pest Management of Horticulture crops	SENT.221	(2+1)	4	3
	7	Introductory Agrometeorology and Climate Change	SAMT.312	(1+1)	3	2
	8	SeedProduction Techniques In Vegetable Crops	SECH.126	(0+2)	4	2
TOTAL				**13+9**	**26**	**22**

III Year V Semester

Sem	Sl. No	CourseTitle	CourseCode	L+P	Credit hrs.	Credit
V	1	Fundamentals of Plant Breeding	SGPB.222	(2+1)	4	3
	2	Growth and Development of Horticultural crops	SHRT.317	(2+1)	4	3
	3	Soil Fertility and Nutrient Management	SSAC.312	(2+1)	4	3
	4	General Microbiology	SAMB.323	(2+1)	4	3
	5	Information and Communication Technology in Horticulture	SHEX.313	(1+2)	5	3
	6	Introductory Crop Physiology	SCPH.312	(1+1)	3	2
	7	Basic Statistics and Experimental Designs	SHST.321	(2+1)	4	3
	8	Education Tour	SEDT.311	(0+2) Non-gradial	4	2
TOTAL				**12+10**	**34**	**20+2**Non-gradial

III Year VI Semester

Sem	Sl. No	CourseTitle	CourseCode	L+P	Credit hrs.	Credit
VI	1	Introductory Agroforestry	SAGR.318	(2+1)	4	3
	2	Laboratory Techniques for Horticultural crops	SHRT.328	(0+2)	4	2
	3	Principles of Biochemistry	SBCM.321	(2+1)	4	3
	4	Dryland Horticulture	SHRT.329	(2+1)	4	3
	5	Economics and Marketing	SAEC.312	(2+1)	4	3
	6	Principles and Practices of Natural Farming	SAGR.214	(1+1)	3	2
	7	Horticulture Based Integrated Farming System	SHRT.321	(2+1)	4	3
	8	Processing and Value Addition of Horticulture crops	SPHM.321	(2+1)	4	3
TOTAL				**13+9**	**31**	**22**

IV Year VII Semester

Sem	Sl.No	CourseTitle	Course Code	L+P	Credit hrs.	Credit.
VII	1	Canopy Management in Fruit crops	SFSC.414	(2+1)	4	3
	2	Production Technology of Warm Season Vegetable crops	SVSC.411	(2+1)	4	3
	3	Postharvest Management of Vegetable crops	SVSC.416	(2+1)	4	3
	4	Commercial Floriculture and Landscaping	SFLA.416	(2+1)	4	3
	5	ProtectedcultivationofVegetablecrops	SVSC.417	(1+1)	3	2
	6	Breeding of Vegetable crops	SVSC.414	(2+1)	4	3
	7	Postharvest handling of Floriculture crops	SFLA.417	(2+1)	4	3
TOTAL				**13+7**	**23**	**20**

IV Year VIII Semester

Sem	Sl. No	CourseTitle	CourseCode	L+P	Credit hrs.	Credit
VIII	1.	Student Ready (RAWE/ Industrial Attachment/ Project work/ Internship)	SSRH 421	(0+20)	40	20
TOTAL				**0+20**	**40**	**20**
					TOTAL	**80+87+4#**
					GRAND TOTAL	**167+10***

*Online courses

TOTAL CREDITS

Semester	Credits
I	23
II	22
III	20
IV	22
V	22
VI	22
VII	20
VIII	20
TOTAL	**171**

SL.NO	COURSE CODE	COURSE TITLE	CREDIT
I. BASIC SCIENCES AND HUMANITIES			
1	SBCM.321	Principles of Biochemistry	3(2+1)
2	SENG.111	Communication Skills	2 (1+1)
3	SHST.311	Basic statistics and experimental design	3 (2+1)
4	SPED.211	Physical Education and Yoga Practices	2 (0+2)
5	SNSS.111/ SNCC.111	National Service Scheme-I/NCC-I	1 (0+1)
6	SNSS.121/ SNCC.121	National Service Scheme-II/NCC-II	1 (0+1)
7	SDAR.111	Deeksharambh	2 (0+2) NG Non-gradial
8	SEDT.311	Education Tour	2 (0+2) NG Non-gradial
		TOTAL	**5+11=16**

SL.NO	COURSE CODE	COURSE TITLE	CREDIT
II. HORTICULTURAL			
1	SHRT.111	Fundamentals of Horticulture	3 (2+1)
2	SHRT.112	Plant Propagation and Nursery Management of Fruit and Plantation crops	3 (1+2)
3	SFLA.111	Commercial production of Flower crops	3(1+2)
4	SPMS.121	Commercial Production of Spices and Plantation crops	3 (2+1)
5	SHRT.123	Plant Propagation and Nursery Management in Vegetables, Flowers and Medicinal crops	3(1+2)
6	SFSC.211	Commercial Fruit Production	4(3+1)
7	SHRT.215	Seed Production of Vegetable, Tuber and Spice crops	3(2+1)
9	SVSC.221	Commercial Vegetable Production	4(3+1)
10	SHRT.226	Urban and Peri Urban Horticulture	2(1+1)
11	SHRT.328	Laboratory Techniques for Horticultural crops	2(0+2)
12	SHRT.329	Dryland Horticulture	3(2+1)
13	SHRT.321	Horticulture Based Integrated Farming System	3(2+1)
14	SPHM.321	Processing and Value Addition of Horticulture crops	3(2+1)
		TOTAL	**22+17=39**

SL.NO	COURSE CODE	COURSE TITLE	CREDIT
AGRONOMY			
1	SAGR.111	Farming Based Livelihood Systems	3 (2+1)
2	SHEG.111	Sprinkler and Micro irrigation systems	2 (1+1)
3	SAGR.122	Introduction to Major Field crops	3 (2+1)
4	SAMT.312	Introductory Agrometeorology and Climate Change	2 (1+1)
5	SAGR.318	Introductory Agroforestry	3 (2+1)
6	SAGR.214	Principles and Practices of Natural Farming	2 (1+1)
		TOTAL	**9+6=15**

SL.NO	COURSE CODE	COURSE TITLE	CREDIT
ECONOMICS			
1	SHEC.312	Agriculture Marketing and Trade	3 (2+1)
2	SAEC.312	Economics and Marketing	3 (2+1)
3	SHEC.211	Entrepreneurship Development And Business Management	3(2+1)
		TOTAL	**6+3=9**

SL.NO	COURSE CODE	COURSE TITLE	CREDIT
ENGINEERING			
1	SHRT.214	Precision Farming and Protected Cultivation	3 (2+1)
2	SHEG.222	Farm Power and Machinery for Horticulture	3 (2+1)
3	SHEG.223	Agricultural Informatics and Artificial Intelligence	3 (2+1)
		TOTAL	**6+3=9**

SL.NO	COURSE CODE	COURSETITLE	CREDIT
ENTOMOLOGY			
1	SENT.221	Pest Management of Horticulture crops	3 (2+1)
		TOTAL	**2+1=3**

SL.NO	COURSE CODE	COURSE TITLE	CREDIT
EXTENSION			
1	SHEX.122	Personality Development	2 (1+1)
2	SHEX.313	Information and Communication Technology in Horticulture	3 (1+2)
		TOTAL	**2+3=5**

SLNO	COURSE CODE	COURSE TITLE	CREDIT
MICROBIOLOGY			
1	SPAT.323	General Microbiology	3 (2+1)
		TOTAL	**2+1=3**

SL.NO	COURSE CODE	COURSE TITLE	CREDIT
CROP PHYSIOLOGY			
1	SHRT.317	Growth and Development of Horticultural crops	3 (2+1)
2	SCPH.312	Introductory Crop Physiology	2 (1+1)
		TOTAL	**3+2=5**

SL.NO	COURSECODE	COURSETITLE	CREDIT
STATISTICS			
1	SHST.311	Basic statistics and experimental design	3 (2+1)
		TOTAL	**2+1=3**

SL.NO	COURSE CODE	COURSE TITLE	CREDIT
FORESTRY AND ENVIRONMENTAL SCIENCE			
1	SAMT.121	Environmental Studies and Disaster Management	3 (2+1)
		TOTAL	**2+1=3**

SL.NO	COURSE CODE	COURSE TITLE	CREDIT
GENETICS AND PLANT BREEDING			
1	SGPB.222	Fundamentals of Plant Breeding	3 (2+1)
		TOTAL	**2+1=3**

SLNO	COURSE CODE	COURSE TITLE	CREDIT
PLANT PATHOLOGY			
1	SPAT.211	Disease Management of Horticulture crops	3 (2+1)
		TOTAL	**2+1=3**

SLNO	COURSE CODE	COURSE TITLE	CREDIT
SOIL SCIENCE & AGRICULTURAL CHEMISTRY			
1	SSAC.211	Fundamentals of Soil Science	3 (2+1)
2	SSAC.122	Soil Fertility and Nutrient Management	3 (2+1)
		TOTAL	**4+2=6**

SKILL ENHANCEMENT COURSES (SEC modules)

SL.No.	COURSE CODE	COURSE TITLE	CREDIT
SKILL ENHANCEMENT COURSES			
1	SECH.111	Mushroom cultivation	2(0+2)
2	SECH.112	Apiculture	2(0+2)
3	SECH.123	Orchard floor management	2(0+2)
4	SECH.124	Landscape gardening	2(0+2)
5	SECH.125	Post harvest management of horticulture produce	2(0+2)
6	SECH.126	Seed production techniques in vegetable crops	2(0+2)
		TOTAL	**0+12=12**

ELECTIVE COURSES

SL.No.	COURSE CODE	COURSE TITLE	CREDIT
FRUIT SCIENCE			
1	SFSC.411	Production Technology of Tropical Fruit crops	3 (2+1)
2	SFSC.412	Production Technology of Sub tropical and temperate Fruit crops	3 (2+1)
3	SFSC.413	Breeding of Fruit crops	3 (2+1)
4	SFSC.414	Canopy Management in Fruit crops	3 (2+1)
5	SFSC.415	Biotechnological Approaches and Micropropagation in Fruit crops	3 (2+1)
6	SFSC.416	Production Technology of Arid Fruit crops	3 (2+1)
7	SFSC.417	Postharvest Management for Fruit crops	2 (1+1)
VEGETABLE SCIENCE			
1	SVSC.411	Production Technology of Warm Season Vegetable crops	3 (2+1)
2	SVSC.412	Production Technology of Cool Season Vegetable crops	3 (2+1)
3	SVSC.413	Production Technology of Tuber crops	3 (2+1)
4	SVSC.414	Breeding of Vegetable crops	3 (2+1)
5	SVSC.415	Biotechnological approaches and Micropropagation in Vegetable crops	3 (2+1)
6	SVSC.416	Postharvest Management of Vegetable crops	3 (2+1)
7	SVSC.417	Protected cultivation of Vegetable crops	2 (1+1)
FLORICULTURE AND LANDSCAPING			
1	SFLA.411	Turf Management	2 (1+1)
2	SFLA.412	Protected Cultivation of Flower crops	3 (2+1)
3	SFLA.413	Value Addition in Floriculture	3 (2+1)
4	SFLA.414	Breeding of Ornamental crops	3 (2+1)
5	SFLA.415	Principles of Landscape Architecture	3 (2+1)
6	SFLA.416	Commercial Floriculture and Landscaping	3 (2+1)
7	SFLA.417	Postharvest handling of Floriculture crops	3 (2+1)

BASIC COURSES

SDAR 111. DEEKSHARAMBH (INDUCTION-CUM-FOUNDATION COURSE)

NON GRADIAL 1(1+0)

OBJECTIVES

- Help for cultural integration of students from different back grounds,
- Know about the operational frame work 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 and research managers of the University

ii. Interaction with alumni, business leaders, perspective employers, outstanding achievers in related fields, and people with inspiring life experiences

iii. Group activities to 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 back grounds.

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.

SENG 111. COMMUNICATION SKILLS 2(1+1)

OBJECTIVES

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

THEORY

UNIT I: 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.

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

UNIT III: Structural and Functional Grammar**:** Sentence structure, modifiers, connecting words and verbal; phrases and clauses; Case: subjective case, possessive case; objective case; Correct usage of nouns, pronouns and antecedents, adjectives, adverbs and articles.

UNIT IV: Agreement of verb with the subject: tense, mood, voice; Writing effective sentences; Basic sentence faults;

LIST OF EXPERIMENTS/ PRACTICES

Listening and note taking; Writing skills: précis 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 and Gyles Brandreth. 1994. How to Interview and be Interviewed. Sheldon Press, London.
3. Carnegie Dale.1997. The Quick and Easy Way to Effective Speaking. Pocket Books, New York.
4. Francis Peter SJ. 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 JamesW. 2003. Intercultural Communication A Contextual Approach. Houghton Miffiin Co Boston.
7. Pease, Allan. 1998. Body Language. Sudha Publications, Delhi.
8. Raman Mand Singh P.2000. Business Communication. Oxford University Press.
9. Seely J.2013. Oxford Guide to Effective Writing and Speaking. Oxford University Press.
10. Thomson AJ and Martinet AV. 1977. A Practical English Grammar. Oxford University

SNSS 111. NATIONAL SERVICE SCHEME (NSS-1) 1(0+1)

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 camps 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

1. Orientation: history, objectives, principles, symbol, badge; regular programs under NSS
2. Organizational structure of NSS, Code of conduct for NSS volunteers, points to be considered by NSS volunteers' awareness about health.
3. 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.
4. 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. Volunteer is mand shramdaan. Indian tradition of volunteerism, its need, importance, motivation, and constraints; shaman as part of volunteerism
5. 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

SNSS 122. NATIONAL SERVICE SCHEME (NSS-I) 1(0+1)

a. Importance and role of youth leadership

b. Meaning, types and traits of leadership, qualities of good leaders; importance and roles of youth leadership, Life competencies

c. Definitionandimportanceoflifecompetencies,problem-solvinganddecision-making

2. Inter personal communication. Youth development programs

a. Development of youth programs and policy at the national level, state level and voluntary sector; youth-focused and youth-led organizations

b. Health,hygieneandsanitation.Definitionneedsandscopeofhealtheducation;roleof 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.

PHYSICAL EDUCATION, FIRST AID, YOGA PRACTICES AND MEDITATION 2(0+2)

OBJECTIVES

i) To make the students aware about Physical Education, First Aid and Yoga Practices

ii) To disseminate the knowledge and skill how to perform physical training, perform first aid and increase stamina and general well being through yoga.

LIST OF EXPERIMENTS/ PRACTICES

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

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

Asanas (Definition and Importance) Padmasan,san, Vajrajasan, Shashankasan, Pashchimotasan, Ushtrasan, Tadasan, Padhastasan, Ardhchandrasan, Bhujangasan, Utanpadasan, Sarvangasan, Parvatasan, Patangasan, Shishupalanasan – 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, Dhyanmudra, 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.

ಕನ್ನಡ ಪತ್ಯಕ್ರಮ

ಕನ್ನಡ ವಿದ್ಯಾರ್ಥಿಗಳಿಗೆ

KAN. 111 **0+1**

ಅ. ಕಾವ್ಯ–ಕಥೆ

ಜನಪದ ಗೀತೆಗಳು–ಜನಪದರು; ಶರಣರ ವಚನಗಳು–ಜೇಡರದಾಸಿಮಯ್ಯ, ಬಸವಣ್ಣ, ಅಯ್ದಕ್ಕಿ ಲಕ್ಕಮ್ಮ; ಹೊಸ ಬಾಳಿನ ಗೀತೆ– ಕುವೆಂಪು; ತಿಳಿದವರೇ ಹೇಳಿ–ವೈದೇಹಿ; ಜೀತ– ಡಾ॥ ಬೆಸಗರಹಳ್ಳಿ ರಾಮಣ್ಣ; ಒಂದು ಖಾಸಗಿ ಪತ್ರ–ಏನಯಾ ಒಕ್ಕುಂದ.

ಆ. ಕೃಷಿ ಬರಹ

ಆಧುನಿಕ ಪೂರ್ವ ಕನ್ನಡ ಕೃಷಿ ಸಾಹಿತ್ಯ ಪರಿಚಯ – ಡಾ॥ಜಿ.ವೀರಭದ್ರಗೌಡ, ಕನ್ನಡದಲ್ಲಿ ಕೃಷಿವಿಜ್ಞಾನ ಸಾಹಿತ್ಯದ ಉಗಮ ಮತ್ತು ವಿಕಾಸ–ಡಾ॥ ಜೆ. ಬಾಲಕೃಷ್ಣ, ಎಲ್ ಫಾರ್ ಲೈನ್ ಅಲ್ಲ: ಲಕ್ಷ್ಮಣಯ್ಯ – ಡಾ॥ ಟಿ.ಎಸ್.ಚನ್ನೇಶ್, ಅಹಾರವೆಂಬ ಆಯುಧ–ನಾಗೇಶ ಹೆಗಡೆ

ಇ. ಪ್ರಾಯೋಗಿಕ

ಅನುವಾದ, ಪಾರಿಭಾಷಿಕ ಪದರಚನೆಯ ವಿಧಾನಗಳು.

ಕನ್ನಡೇತರ ವಿದ್ಯಾರ್ಥಿಗಳಿಗೆ/ **For Non Kannada Speaking Students**

AGRICULTURAL AND ALLIED SUBJECTS

AGRONOMY

SAGR 111. FARMING BASED LIVELIHOOD SYSTEMS 3(2+1)

OBJECTIVE

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

THEORY

UNIT I Status of agriculture in India and different states, Income of farmers and rural people in India, Livelihood-Definition, concept and livelihood pattern in urban and rural areas, Different indicators to study livelihood systems. Agricultural livelihood systems (ALS): Meaning, approach, approaches and framework, Role of farming-based livelihood enterprises in 21st Century in view of circular economy, green economy, climate change, digitalization and changing life style.

UNIT II Definition of farming systems and farming based livelihood systems Prevalent Farming systems in India contributing to livelihood. Types of traditional and modern farming systems. Components of farming system/ farming-based livelihood systems- Crops and cropping systems, Livestock (Dairy, Piggery, Goatry, Poultry, Duckry etc.), Horticultural crops, Agro--forestry systems, Aqua culture Duck/Poultry cum Fish, Dairy cum Fish, Piggery cum Fish etc.,

UNIT III 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,

UNIT IV Case studies on different livelihood enterprises associated with the farming. Risk and success factors in farming-based livelihood systems, Schemes and programs by Central and State Government, Public and Private organizations involved in promotion of farming-based livelihood opportunities.

LIST OF EXPERIMENTS/ PRACTICES

- Survey of farming systems and agricultural based livelihood enterprises,
- Study of components of important farming based livelihood models/ systems in different agro-climatic zones,

- Study of production and profitability of crop based, livestock based, processing based and integrated farming based livelihood models,
- Field visit of innovative farming system models.
- Visit of Agri-based enterprises and their functional aspects for integration of production, processing and distribution sectors
- Study of agri-enterprises involved in industry and service sectors (Value Chain Models),
- Learning about concept of project formulation on farming-based livelihood systems along with cost and profit analysis,
- Case study of Start-Ups in agri-sectors.

Suggested Readings

1. Ashley, C. and Carney, D. 1999. Sustainable Livelihoods: Lessons from Early
2. Experience; Department for International Development: London, UK; Volume 7. [Google Scholar]
3. Agarwal, A. and Narain, S. 1989. Towards Green Villages: A strategy for Environmentally, Sound and Participatory Rural Development, Centre for Science and Environment, New Delhi, India
4. Carloni,A. 2001. Global Farming Systems Study: Challenges and Priorities.
5. Analysis: Sub-Saharan Africa, Consultation Document, FAO, Rome, Italy
6. 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
7. Evenson, R.E. 2000. Agricultural Productivity and Production in Developing Countries'. In FAO, The State of Food and Agriculture, FAO, Rome, Italy
8. Livelihood Improvement of Underprivileged Farming Community: Some Experiences from Vaishali, Samastipur, Darbhanga and Munger Districts of Bihar by B.P. Bhatt, Abhay Kumar,
9. 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 Parisar, P.O. Bihar Veterinary College, Patna-800014, Bihar
10. Panwar et al. 2020. Integrated Farming System models for Agricultural Diversification, Enhanced Income and employment, Indian Council of Agricultural Research, New Delhi.
11. Reddy, S.R. 2016. Farming System and Sustainable Agriculture, Kalyani Publish New Delhi.

12. Singh, J.P., et al. 2015. Region Specific Integrated Farming System Models, ICAR-Indian Institute of Farming Systems Research, Modipuram.
13. Walia, S. S. and Walia, U. S. 2020. Farming System and Sustainable Agriculture, Scientific Publishers, Jodhpur, Rajasthan.

SAGR 112. FUNDAMENTALS OF AGRONOMY 3 (2 +1)

OBJECTIVES

1. To impart the basic and fundamental knowledge of Agronomy

THEORY

UNIT I 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.

UNIT II 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/uncombined forms. Manures and fertilizers, nutrient use efficiency: Sources of nutrients: Inorganic (fertilizers), organic (manures) and bio-fertilizers; their classification and characteristics, method of preparation and role of organic manures in crop production. Integrated Nutrient Management (INM): Meaning, different approaches and advantages of INM. Green manure- role in crop production: Definition, objectives types of green manuring, desirable characteristics, advantages and limitations of green manuring.

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

UNIT IV Weeds: Definition, Importance and basics of classification of weeds and their control. Agroclimatic zones of India and the state, cropping systems: Factors affecting cropping systems, major cropping patterns and systems in the country. Sustainable crop production: Definition, importance and practices, natural resources and conservation

pollution and pollutants, Allelopathy: Meaning and importance in crop production, Growth and development of crops: Definition, Meaning and factors affecting growth and development.

LIST OF EXPERIMENTS/ PRACTICES

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

Suggested readings

- RaoVS.1992.Principles of Weed Science. Oxford and IBH Publishing Co.Ltd. New Delhi
- Reddy Yellamanda T and Shankar Reddy GH.1995. Principles of Agronomy. Kalyani Publishers,
- Ludhiana.
- Reddy, S.R.2008. Principle of Crop Production, Kalyani Publisher, Ludhiana.
- William L Donn.1965. Meteorology. McGraw-Hill Book Co. New York.
- Yawalkar K SandAgarwalJP.1977. Manures and Fertilizers. Agricultural Horticultural
- Publishing House, Nagpur.

SAGR 213. CROP PRODUCTION TECHNOLOGY-1 (*KHARIF* CROPS) 3 (1+2)

OBJECTIVES

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

THEORY

UNIT I Origin, geographical distribution, economic importance, soil and climatic requirements, varieties, cultural practices and yield of *Kharif* crops. Cereals- rice, maize,

UNIT II Origin, geographical distribution, economic importance, soil and climatic requirements, varieties, cultural practices and yield of *Kharif* crops, sorghum, pearl millet, finger millet and other minor millets,

UNIT III Origin, geographical distribution, economic importance, soil and climatic requirements, varieties, cultural practices and yield of pulses- pigeonpea, mungbean and urdbean; oilseeds- groundnut, soybean, sesame, castor;

UNIT IV Origin, geographical distribution, economic importance, soil and climatic requirements, varieties, cultural practices and yield of fibre crops- cotton and jute; forage crops- sorghum, cowpea, cluster bean, maize, guinea and napier.

LIST OF EXPERIMENTS/ PRACTICES

- Rice nursery preparation, transplanting of rice
- Sowing of soybean, pigeon pea and mungbean, maize, groundnut and cotton
- Effect of seed size on germination and seedling vigour of *Kharif* crops
- Effect of sowing depth on germination of *Kharif* crops
- Identification of weeds in *Kharif* crops
- Top dressing and foliar feeding of nutrients
- Study of yield contributing characters and yield calculation of *Kharif* crops
- Study of crop varieties and important agronomic experiments at experiential farm, recording biometric observation
- Study of forage experiments, morphological description of *Kharif* crops, silage and hay making, visit to research centres of related crops.

Suggested Readings

1. B.Gurarajan, R. Bala subramanian and V. Swaminathan. Recent Strategies on Crop Production. Kalyani Publishers, New Delhi.

2. Chidda Singh.1997. Modern techniques of raising field crops. Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi.

3. Rajendra Prasad. Text book of Field Crops Production-Commercial Crops. Volume IIICAR Publication.

4. S.R. Reddy.2009. Agronomy of Field Crops. Kalyani Publishers, New Delhi.

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

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

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

SAGR 225. CROP PRODUCTION TECHNOLOGY-II (*RABI* CROPS) 3(1+2)

OBJECTIVES

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

THEORY:

UNIT I Origin, geographical distribution, economic importance, soil and climatic requirements, varieties, cultural practices and yield of *Rabi* crops.

UNIT II Cereals- wheat and barley. Pulses- chickpea, lentil, peas. *Rabi* redgram and, rajmash. Oilseed- rapeseed, mustard, sunflower, safflower; and linseed. Sugar crops- sugarcane and sugar beet

UNIT III. Medicinal and aromatic crops- mentha, lemon grass and citronella.

UNIT IV Forage crops –barseem, lucerne and oat; potato, quinoa, tobacco.

LIST OF EXPERIMENTS/ PRACTICES

- 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

1. B. Gurarajan,R. Bala subramanian and V.Swaminathan. Recent Strategies on Crop Production. Kalyani Publishers, New Delhi.

2. Chidda Singh.1997.Modern techniques of raising field crops. Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi.

3. Rajendra Prasad. Text book of Field Crops Production-Commercial Crops.Volume IIICAR Publication.

4. Rajendra Prasad. Textbook of Field Crops Production Food grain Crops. Volume I ICAR Publication.

5. S.R.Reddy.2009. Agronomy of Field Crops. Kalyani Publishers, New Delhi.

6. S.S.Singh.2005. Crop Management. Kalyani Publishers, NewDelhi.

7. Rajendra Prasad.2002. Text Book of Field Crops Production, ICAR, NewDelhi.

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

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

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

SAGR 226. WATER MANAGEMENT 2 (1+1)

OBJECTIVES

1. To study the important properties of soil affecting water availability to crops and water requirement for optimum growth and development

2. To study different methods of irrigation and water management practices of both field and horticultural crops and drainage.

3. To study the soil moisture conservation practices including management of rain water, watershed and command areas.

Theory

UNIT I: 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.

UNIT II 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

UNIT III Layout of different irrigation systems, Irrigation efficiency and water use efficiency, conjunctive use of water, irrigation water quality and its management. Layout of underground pipeline system, Irrigation automation, Artificial Intelligence and climate-based irrigation practices and its management.

UNIT IV Water management of different crops (rice, wheat, maize, groundnut, sugarcane, mango, banana and tomato); quality of irrigation water, irrigation management practices for different soils and crops, drip, sprinkler.

LIST OF EXPERIMENTS/ PRACTICES

- Determination of bulk density by field method;
- Determination of soil moisture content by gravimetric method, tensiometer, electrical resistance block and neutron moisture meter;
- Determination of field capacity by field method;
- Determination of permanent wilting point;
- Measurement of irrigation water by using water measuring devices viz., flumes, weirs, notches, orifices;
- Calculation of irrigation water requirement (Problems);
- Determination of infiltration rate; Demonstration of furrow method of irrigation;
- Demonstration of check basin and basin method of irrigation;
- Visit to farmers' field and cost estimation of drip irrigation system;
- Demonstration of filter cleaning, fertigation, injection and flushing of laterals;
- Layout for different methods of irrigation,
- Erection and operation of sprinkler irrigation system;
- Measurement of emitter discharge rate, wetted diameter and calculation of emitter discharge variability;
- Visit to irrigation research centre/ station and visit to command area.

Suggested Readings

1. Rao, Y.P. and Bhaskar, S.R. Irrigation technology. Theory and practice. Agrotech publishing Academy, Udaipur.
2. Dilipkumar Mujmdar. Irrigation water management: Principles and Practices. Prentice Hall of India Pvt. Ltd.,
3. S.V. Patil &Rajakumar, G. R., Water Management in Agriculture and Horticultural Crops. Satish serial publishing House, Delhi.

4. Carr M. K. V. and Elias Fereres. Advances in Irrigation Agronomy. Cambridge University Press.

5. Michael, A.M. Irrigation Theory and practice. Vikas publishing house Pvt, Ltd.

SAGR 317. WEED MANAGEMENT 2 (1+1)

OBJECTIVES

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

THEORY

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

UNIT II 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.

UNIT III Herbicide classification and properties of important herbicides, concept of adjuvants, surfactants, herbicide formulation and their use, Nano herbicides, precision weed management; Mode of action of herbicides and selectivity phenomenon.

UNIT IV Concept of herbicide mixture and utility in agriculture, Herbicide compatibility with agro-chemicals and their application, Herbicide resistance and its management. Weed management in different field and horticultural crops; aquatic weed management, weed management in cropping systems.

LIST OF EXPERIMENTS/ PRACTICES

- Techniques of weed preservation, weed identification and losses caused by weeds.
- Biology of important weeds.
- Study weeds in different situations,
- Study of herbicide formulations and mixture of herbicide.
- Study methods of herbicide application,
- Herbicide application equipment- their parts, use, maintenance and calibration.
- Weed control implements,

- Calculation of herbicide and requirement weed control efficiency and weed index,
- Phytotoxicity of herbicides,
- Weed management in fallow lands,
- Management of problem and parasitic weeds.

Suggested Readings

1. Crafts, A.S. and Robbins, W.W. 1973. Weed Control. Tata Mc Graw-Hill Publishing Co. Ltd., New Delhi.

2. Gupta, O.P. 1984. Scientific Weed Management. Today and Tomorrow Printers and Publishers, New Delhi.

3. Gupta, O. P. 2015. Modern Weed Management. Agro Bios (India), Jodhpur.

4. Naidu,V.S.G.R. Hand book of Weed Identification. Directorate of Weed Research, Jabalpur.

5. Rajagopal, A., Aravindan, R. and Shanmugavelu, K.G. 2015. Weed management of Horticultural Crops. Agrobios (India), Jodhpur.

6. Ramamoorthy, K. and Subbian, P. Predominant Weed florain hill–ecosystems. Agrobios (India), Jodhpur.

7. Rao, V.S. 2000. Principles of Weed Science. Oxford & IBH Publishing Co., New Delhi.

8. Subramanian,S., Mohammed Ali,A. and Jayakumar, R.1991. All About Weed Control. Kalyani Publishers, Ludhiana.

9. Tadulingam, C. and Venkatnarayana, D. 1955. A Handbook of Some South Indian Weeds. Government Press, Madras.

10. Thakur, C. 1977. Weed Science. Metropolitan Book Co. Pvt. Ltd., New Delhi.

SAGR 329. DRYLAND AGRICULTURE/RAINFED AGRICULTURE AND WATERSHED MANAGEMENT 2(1+1)

OBJECTIVES

1. To learn about characteristics and conditions of dryland/ rainfed agriculture
2. To gain knowledge about drought and its mitigation
3. To impart knowledge on water harvesting and watershed management.

THEORY

UNIT I: 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;

UNIT II Length of Growing Period (LGP) and Soil Moisture Availability (SMA) and its impact on crop and cropping system; Soil and water conservation techniques; Drought: types, effect of water deficit on physio- morphological characteristics of the plants; Crop adaptation and mitigation to drought;

UNIT III Water harvesting: importance, its techniques, Efficient utilization of water through soil and crop management practices; Crops and cropping systems in dry land/rainfed areas; Management of crops in dry land/rainfed areas; Concept, history, objective, principles and components of watershed management, factors affecting watershed management.

UNIT IV Contingent crop planning for aberrant weather conditions; Long term rainfall analysis in relation to simple mathematical models and forecasting the weather abnormalities; Alternate land use system location; regional and crop specific dryland principles and practices for profitable and sustainable dryland farming and allied enterprises.

LIST OF EXPERIMENTS/ PRACTICES

- Studies on climate classification,
- Studies on rainfall pattern in rainfed areas of the country and pattern of onset and withdrawal of monsoons.
- Calculation of Length of Growing Period (LGP) and Soil Moisture Availability (SMA)
- Studies on cropping pattern of different rainfed areas in the country and demarcation of rainfed area on map of India.
- Interpretation of meteorological data and scheduling of supplemental irrigation on the basis ofevapo-transpiration demand of crops.
- Critical analysis of rainfall and possible drought period in the country. Effective rainfall and its calculation.
- Studies on cultural practices for mitigating moisture stress including mechanical and agronomic measure.
- Soil moisture determination under different land situations, Importance of seed priming to mitigate drought.
- Assessment of meteorological drought.
- Characterization and delineation of model watershed.
- Seed treatment, viz., seed hardening and seed priming techniques for all the agricultural crops

- Field demonstration on soil and moisture conservation measures.
- Field demonstration on construction of water harvesting structures.
- Visit to rainfed research station/watershed.

Suggested readings

1. A.K. Srivastava and P.K. Tyagi. 2011. Practical Agricultural Meteorology. New Delhi Publishing Agency, New Delhi.
2. D. Lenka. 2006. Climate, Weather and Crops in India. Kalyani Publishers, NewDelhi.
3. G.S.L.H.V. Prasad Rao.2008. Agricultural Meteorology. Prentice Hall of India Pvt. Ltd., New Delhi.
4. H.S. Mavi and Graeme J. Tupper. 2005. Agrometeorology – Principles and applications of climate studies in agriculture. International Book Publishing Co., Lucknow.
5. H.S. Mavi.1994.Introduction to Agrometeorology. Oxford and IBH Publishing Co.Pvt. Ltd., New Delhi.
6. H.V. Nanjappa and B.K. Ramachandrappa. 2007. Manual on Practical Agricultural Meteorology. Agrobios India. Jodhpur.
7. S.R.Reddy.1999. Principles of Agronomy. Kalyani Publishers, New Delhi.
8. T. Yellamanda Reddy and G.H. Sankara Reddi.2010. Principles of Agronomy. Kalyani Publishers, New Delhi.

SAGR 214. PRINCIPLES AND PRACTICES OF NATURAL FARMING 2 (1+1)

OBJECTIVES

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

THEORY

UNIT I 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), 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.

UNIT II 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

UNIT III 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

UNIT IV 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),

LIST OF EXPERIMENTS/ PRACTICES

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

Suggested readings:

1. Ayachit, S.M. 2002. Kashyapi Krishi Sukti (A Treatise on Agriculture by Kashyapa). Brig Sayeed Road, Secunderabad, Telangana: Asian Agri-History Foundation 4: 205.

2. Boeringa, R. (Eed.). 1980. Alternative Methods of Agriculture. Elsevier, Amsterdam, 199pp.

3. Das, P., Das, S.K., Arya, H.P.S., Reddy, G. Subba, Mishra, A. and others: Inventory of Indigenous Technical Knowledge in Agriculture: Mission mode Project on Collection, Documentation and Validation of Indigenous Technical Knowledge, Document 1 To 7, Indian Council of Agricultural Research, New Delhi.

4. Ecological Farming -The seven principles of a food system that has people at its heart. May 2015, Greenpeace.

5. Ecological Farming, The Seven principles of a food system that has people at its heart. May 2015, Greenpeace

6. FAO. 2018. The 10 elements of agro-ecology: guiding the transition to sustainable food and agricultural system.https://www.fao.org/3/i9037en/i9037en.pdfAgro ecosystem Analysisfor Research and Development Gordon R. Conway.1985.

7. Fukuoka,M.1978.TheOne-StrawRevolution:AnIntroductiontoNaturalFarming. Rodale Press, Emmaus, PA. 181 pp

8. Fukuoka, M. 1985. The Natural Way of Farming: The Theory and Practice of Green Philosophy. Japan Publications, Tokyo, 280 pp.

9. Hill S.B and Ott. P. (Eeds.). 1982. Basic Techniques in Ecological Farming Berkhauser Verlag, Basel, Germany, 366 pp.

10. Hill, S.B. and Ott, P. (Eeds.). 1982. Basic Techniques in Ecological Farming. Berkhauser Verlag, Basel, Germany, 366 pp.

11. HLPE. 2019. Agroeeological and other innovative approaches for sustainable agriculture and food systems that enhance food security and nutrition. A report by the High Level Panel of Experts on Food Security and nutrition of the Committee on World Food Security, Rome. https://fao.org/3/ea5602en/ea5602en.pdf.

12. INFRC.1988.Guidelines for Nature Farming Techniques. Atami, Japan. 38pp.

13. Khurana, A. and Kumar, V. 2020. State of Organic and Natural Farming: Challenges and Possibilities, Centre for Science and Environment, New Delhi.

14. Malhotra R. and S.D. Babaji. 2020. Sanskrit Non Translatable- The importance of Sanskritizing English. Amaryllis, New Delhi India.

15. Nalini, S. 1996. Vrikshayurveda (The Science of Plant Life) by Surapala. AAHF Classic Bulletin 1. Asian Agri-History Foundation, Brig Sayeed Road, Secunderabad, AP (now Telengana), India. 94pp.

16. Nalini, S. 1999. Krishi-Parashara (Agriculture by Parashara) by Parashara. Brig Sayeed Road, Secunderabad, Telangana: AAHF Classic Bulletin, Asian Agri-History Foundation. 104pp.

17. Nalini, S. 2011. Upavana Vinoda (Woodland Garden for Enjoyment) by Sarangdhara (13th century CE): AAHF Classic Bulletin 8. Asian Agri-History Foundation, Brig Sayeed Road, Secunderabad, AP (now Telangana), India. 64p

18. NaturalAssetFarming:CreatingProductiveandBiodiverseFarmsbyDavidB.Lindenmayer, Suzannah M. Macbeth, et al. (2022)

19. NaturalFarmingTechniques:FarmingwithouttillingbyPrathapanParamu(2021)

20. ReyesTirado.2015.Ecological Farming-Thes even principles of a food system that has people at its heart. Greenpeace Research lab. University of Exeter, Ottho Heldring straat.

21. Shamasastry,R.1915. Kautilya's Arthashastra.

22. The Ultimate Guide to Natural Farming and Sustainable Living: Permaculture for Beginners (Ultimate Guides) by Nicole Faires (2016)

23. U.K. Behera. 2013.A text Book of Farming System. Agrotech Publishing House, Udaipur.

SAMT 312. INTRODUCTION TO AGRO-METEOROLOGY 2(1+1)

OBJECTIVES

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

THEORY

UNIT I: 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;

UNIT II 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, Application of Thermal time concept and Crop/Pest weather calendar;

UNIT III Energy balance of earth; Atmospheric humidity, concept of saturation, vapour pressure, process of condensation, formation of dew, fog, mist, frost, cloud; Precipitation, process of precipitation, types of precipitation such as rain, snow, sleet, and hail, cloud formation and classification; Artificial rainmaking. Monsoon- mechanism and importance in Indian agriculture;

UNIT IV Weather hazards - drought, floods, frost, tropical cyclones and extreme weather conditions such as heat-wave and cold-wave; Agriculture and weather relations; Modifications of crop microclimate, climatic normal for crop and livestock production. Weather forecasting- types of weather forecast and their uses. Climate change, climatic variability, global warming, causes of climate change and its impact on regional and national agriculture.

LIST OF EXPERIMENTS/ PRACTICES

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

- Use of synoptic charts, weather reports, weather forecasting-types and methods, crop weather calendar.

Suggested Readings

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

SOIL SCIENCE AND AGRICULTURAL CHEMISTRY

SSAC 111. FUNDAMENTALS OF SOIL SCIENCE 3(2+1)

OBJECTIVE

To impart knowledge on soil genesis, basics oil properties with respect to plant growth

Theory

UNIT I: Soil: Pedological and edaphalogical concepts. Rocks and minerals, weathering, keys taxonomy to soil orders. Soils of India Silicate clays: constitution and properties, sources of charge, ion exchange, cation and anion exchange capacity and base saturation (after buffering capacity),

UNIT II: Soil formation, Soil organic matter, Pedogenic processes, Soil colloids: inorganic and organic, Properties of soil colloids. Ion exchange in soils, Soil profile,

UNIT III: Soil texture, soil structure. Bulk density and particle density, soil consistency,

UNIT IV: Soil temperature, soil air, soil water. Soil reaction and buffering capacity.

LIST OF EXPERIMENTS/PRACTICES

1. Study of general properties of minerals,
2. Study of minerals-silicate and non-silicate minerals,
3. Study of rocks-igneous, sedimentary and metamorphic rocks;
4. Study of a soil profile,
5. Collection and processing of soil for analysis,
6. Study of soil texture-feel method, mechanical analysis,
7. Determination of particle density and soil porosity,
8. Determination of soil colour,
9. Study of soil structure and aggregate analysis,

10. Determination of soil moisture,
11. Determination of soil moisture constants- field capacity; water holding capacity.
12. Study of infiltration rate of soil,
13. Determination of pH and Electrical conductivity of soil.

Suggested readings

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

SSAC 122. SOIL FERTILITY MANAGEMENT 3(2+1)

OBJECTIVE

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

THEORY

UNIT I: 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, and rapid plant tissue tests. Indicator plants.

UNIT II: Introduction and importance of manures and fertilizers. Fertilizer recommendation approaches.

UNIT III: Integrated nutrient management. Chemical fertilizers: classification, composition and properties of major fertilizers, secondary and micronutrient fertilizers, Complex fertilizers, Customized fertilizers, water soluble fertilizers nano fertilizers Soil amendments, Fertilizer Storage, Fertilizer Control Order. Methods of fertilizer recommendations to crops. Factor influencing nutrient use efficiency (NUE),

UNIT IV: Methods of application under rainfed and irrigated conditions. STCR/RTNM/ IPNS, Carbon sequestration and Carbon Trading, Preparation and properties of major manures (FYM, Compost, Vermicompost, Green manuring, Oilcakes).

LIST OF EXPERIMENTS/PRACTICES

1. Introduction of analytical instruments and their principles, calibration and applications
2. Colorimetry and flame photometry;
3. Estimation of alkaline hydrolysable N in soils;
4. Estimation of soil extractable P in soils;
5. Estimation of exchangeable K in soils;
6. Estimation of exchangeable Ca and Mg in soils;
7. Estimation of soil extractable S in soils;
8. Estimation of DTPA extractable Zn in soils;
9. Estimation of N in plants;
10. Estimation of P in plants;
11. Estimation of K in plants;
12. Estimation of S in plants.

Suggested readings

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

SSAC 223. PROBLEMATIC SOILS AND THEIR MANAGEMENT 2(1+1)

OBJECTIVES

1. To acquaint the students about various problem soils like degraded soils, acid soils, saline soils, alkalisoils, 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

UNIT I: Soil quality and health, Distribution of Waste land and problem soils in India, Categorization of Problem soils based on properties. Reclamation and management of Acid soils, Saline, Sodic soils, Acid Sulphate soils,

UNIT II: Eroded and Compacted soils, polluted soils. Contaminated soils (Pesticide contamination, Heavy metal contamination), Mined soils (Coalmined, Oil mined).

UNIT III: Management of Riverine soils, Water logged soils, Irrigation water–quality and standards, utilization of saline water in agriculture.

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

LIST OF EXPERIMENTS/PRACTICES

- 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
- Computation of SAR and ESP and characterization of problematic soil.
- Determination of Gypsum requirement of alkali / sodic soil.
- Determination of lime requirement of acidic soil.
- Determination of Quality of irrigation water (pH, EC, Ca, Mg, Na, CO3, HCO3, Cl, SAR and RSC),
- Determination of nitrate (NO3-) from irrigation water,
- Determination of dissolved oxygen and free carbon dioxide levels in water samples.

Suggested readings

1. Agarwal, R.R., Yadav, J.S.P. and Gupta, R.N. (1982). Saline Alkali soils of India, ICAR, AGROBIOS (India).

2. Brady NyleC and RayR Well., 2014. Nature and properties of soils. Pearson Education Inc., New D Delhi.

3. Cirsan J.Paul.,1985,.Principles of Remote Sensing. Longman,NewYork

4. Indian Society of Soil Science., 2002. Fundamentals of Soil Science. IARI, NewDelhi.

5. Srivastava, V.C.,2002. Management of Problem Soils- Principles and Practices New Delhi

DEPARTMENT OF HORTICULTURE

SHRT 111. 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
- 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

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

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

UNIT III: Principles of orchard establishment, principles and methods of training and pruning of fruit crops, Juvenility and flower bud differentiation, unfruitfulness in horticultural crops.

UNIT IV: Pollination, pollinizers and pollinators, fertilization and parthenocarpy, importance of bio regulators in horticultural crops, irrigation and its methods, Fertilizer application in horticultural crops.

LIST OF EXPERIMENTS/PRACTICES

- 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 of horticultural crops
- Harvesting and grading
- Packaging and storage

Suggested readings

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

SHRT 212. PRODUCTION TECHNOLOGY OF FRUIT AND PLANTATION CROPS

2(1+1)

OBJECTIVES

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

THEORY

UNIT I: Production status of fruit and plantation crops: Importance and scope of fruit and plantation crop industry in India; nutritional value of fruit crops; classification of fruit crops; area, production, productivity and export potential of fruit and plantation crops.

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

UNIT III: Fruit crops: mango, banana, papaya, guava, sapota, citrus, grape, litchi, pineapple, pomegranate, apple, pear, peach, strawberry, nut crops Jackfruit and minor fruits- date, ber and apple.

UNIT IV: Plantation crops-coconut, arecanut, cashew, tea, coffee and rubber. Crop production techniques in palms and plantation crops: Climate and soil requirements, varieties, propagation, nursery management ,planting and planting systems, cropping systems, aftercare, training and pruning for plantation crops, water, nutrient and weed management, intercropping, multi-tier cropping system, mulching, special horticultural practices, maturity indices, harvest and yield, pests and diseases, processing- value addition of palms: Coconut, Arecanut, Oil palm and Palmyrah, Plantation crops: Tea, Coffee, Cocoa, Cashewnut, Rubber.

LIST OF EXPERIMENTS/PRACTICES

- Propagation techniques, selection of planting material and varieties
- Important cultural practices for mango, banana, papaya, guava, sapota, grapes, Citrus (mandarin and acid lime), pomegranate and jackfruit
- Preparation and application of PGR's for propagation

- Micro propagation
- Protocol for mass multiplication and hardening of fruit crops
- Identification and description of varieties, mother palm and seed nut selection
- Nursery practices and seedling selection
- Fertilizers application
- Nutritional disorders
- Pests and diseases of Coconut, Arecanut and cocoa, Tea and coffee, Rubber and cashew,
- Visit to commercial orchard and plantation industries.

Suggested Readings

1. Banday, F.A. and Sharma, M.K. 2010 Advances intemperate fruit production. Kalyani Publishers, Ludhiana
2. Bose,T.K.,S.K. Mitra and D. Sanyal 2001. Fruits: Tropical and Subtropical (2volumes) Naya Udyog, Calcutta.
3. Bose,T.K., S.K.Mitra, A.A.Farooqi and M.K. Sadhu (Eds).1999.Tropical Horticulture Vol.1. Naya Prokash, Calcutta.
4. Chadha,K.L.2001. Hand book of Horticulture. ICAR, Delhi
5. Chadha, T.R. 2001Text book of temperate fruits. ICAR, New Delhi
6. Chattopadhyay,T.K. 2001. A Text Book on Pomology (4 volumes). Kalyani Publishers, Ludhiana.
7. Chattopadhyay. 1998. A text book on pomology (sub-tropical fruits) vol.III. Published by M/s. Kalyani publishers, Ludhiana, New Delhi, Noida. UP.
8. Chudawat, B.S.1990. Arid fruit culture Oxford & IBH, New Delhi
9. Das,B.C. and Das S.N.Cultivation of minor fruits.Kalyani Publishers, Ludhiana
10. DavidJacksonandN.E.Laone,1999.Subtropicalandtemperatefruitproduction.CABI publications
11. H.P. Singh and M.M.Mustafa2009.Banana-new innovations West ville publishing House,New Delhi
12. Kumar,N.1997. Introduction to Horticulture. Rajalakshmi Publications, Nagercoil,Tamil Nadu.

13. Mitra,S.K.,T.K.BoseandD.S.Rathore.1991.Temperate fruits. Horticulture and allied Publishers, Calcutta.
14. Pal,J.S.1997. Fruit Growing. Kalyani Publishers, NewDelhi.
15. Radha,T.andMathew,L.2007.Fruitcrops.NewIndiapublishingAgency
16. Rajput,CBSandSriharibabu,R.1985.Citriculture,KalyaniPublishers,Ludhiana
17. Sadhu,M.K. and P.K. Chattopadhyay.2001.Introductory Fruit Crops. Naya Prokash, Calcutta.
18. Singh,S.P.2004.Commercial Fruits. Kalyani Publishers, Ludhiana
19. Symmonds. 1996. Banana, II Edn. Longman, London
20. Veeraragavathatham, D., Jawaharlal, M., Jeeva, S., Rabindran, R and Umapathy, G. 2004 (2ndedition).Scientific fruit culture. Published by M/s. Suri associates,1362/4,VelrajVihar Complex, Thadagam Road, Coimbatore- 2
21. W.S.Dhillon.2013.Fruit production in India. Narendra publishing House, NewDelhi
22. Kavino,M,V. Jegadeeswari, R.M. Vijayakumarand S. Balkrishnan. 2018. Production Technology of Fruits and Plantation Crops by Narendra Publishing House.
23. Kumar, N.J.B.M. Md.Abdul Khaddar, Ranga Swamy, P. And Irulappan, I.1997. Introduction to spices, Plantation crops and Aromatic plants. Oxford & IBH, New Delhi.
24. Nair.1979.Cashew,CPCRI,Kerela
25. Sharma, A., Kumar, P., Tripathi, V.K. 2024. Production Technology of Fruits and Plantation Crops. Elite Publishing House
26. Thampan,P.K.1981. Hand book of coconut palm. Oxford & IBH, New Delhi.
27. Thompson,P.K.1980.Coconut.Oxford&IBH,NewDelhi
28. V. Ponnuswami, M. Kumar; S. Ramesh Kumar and C.Krishna moorthy 2015. Fruit and Plantation Crops Narendra Publishing House.

SHRT 223. PRODUCTION TECHNOLOGY OF VEGETABLES AND SPICES 2(1+1)

OBJECTIVES

- To educate bout the different forms of classification of vegetables
- To educate about the origin, area, climate, soil, improved varieties and cultivation practices of vegetables and spices
- To educate about the physiological disorders of vegetables and spices

THEORY

UNIT I: Importance of vegetables and spices in human nutrition and national economy, kitchen gardening

UNIT II: 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

(tomato,okra,brinjal,chili,capsicum,cucumber,bittergourd,bottlegourd,sweetpotato,cassava and moringa, pumpkin, French bean and peas

UNIT III: 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; 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,

UNIT IV: 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 spice crops like turmeric, zinger, garlic, coriander, cumin, black pepper, cardamom, fenugreek, fennel, clove, nutmeg, cinnamon, curry leaf, tamarind and herbal spices.

LIST OF EXPERIMENTS/PRACTICES

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

Suggested readings

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

SHRT 314. ORNAMENTAL CROPS, MAPS AND LANDSCAPING 2(1+1)

OBJECTIVES:

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

THEORY

UNIT I: Importance and scope of ornamental crops and landscaping; Principles of landscaping; Landscape uses of trees, shrubs and climbers, Brief concept of Home landscaping, Carpet bedding, Topiary, Bonsai, Lawn, flower arrangement, Herbaceous Border, Hedge, Edge etc

UNIT II: Production technology of important cut flowers like rose, gerbera and orchids, gladiolus, tuberose, lilium, chrysanthemum and carnation

UNIT III: Package of practices for loose flowers like marigold and jasmine under open conditions, Processing and value addition imp ornamental crops

UNIT IV: Importance and scope of medicinal and aromatic plants, Production technology of ashwagandha, costus, isabgol, geranium, mint, aloe and ocimum, Coleus, Glory lily, Periwinkle, lemongrass, citronella, vetiver and palmarosa etc., Processing and value addition of MAPs produce.

LIST OF EXPERIMENTS/PRACTICES

- Identification of MAPs
- Identification of 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, orchids and bougainvillea
- Planting of gerbera suckers and Gladiolus corms
- Training and pruning of ornamental plants and raising of hedge and edge
- Planning and layout of garden
- Establishment and maintenance of lawn
- Preparation of flower preservatives and their use in extending the vase life of cut flowers

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. Text book of floriculture and land scaping by AnilK. Singh and Anjana Sisodia
4. Commercial flowers (Vol1and2) by T.K. Bose.

GENETICS AND PLANT BREEDING

SGPB 211. PRINCIPLES OF GENETICS 3(2+1)

OBJECTIVE

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

THEORY

UNIT-I: Introduction and definition of cytology, genetics and cytogenetics and their interrelation. Chromosomal theory of inheritance- cell cycle and cell division-mitosis and meiosis.Architecture of chromosomes, chromonemata, chromosome matrix, chromomeres, centromere, secondary constriction and telomere, special types of chromosomes. Types of DNA and RNA. Structural and numerical variations in chromosomes and their implications, Use of haploids, dihaploids and double haploids in Genetics.

UNIT-II: Pre and post Mendelian concepts of heredity, Mendelian principles of heredity, Probability and Chi-square, Study of model organisms (Drosophila, Arabidopsis, Garden pea,

E. coli, and mice), 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.

UNIT III: Mutation, classification, Methods of inducing mutations, mutagenic agents and induction of mutation. Qualitative and quantitative traits, Polygenes and continuous variations, multiple factor hypothesis, Cytoplasmic inheritance.

UNIT IV: Nature, structure and replication of genetic material, Protein synthesis, Transcription and translational mechanism of genetic material, Gene concept: Gene structure, function and regulation.

LIST OF EXPERIMENTS/ PRACTICES

1. Study of microscope, study of cell structure, mitosis and meiosis cell division.
2. Study on models on DNA and RNA structures.
3. Experiments on probability and chi-square test.
4. Experiments on monohybrid, dihybrid, trihybrid, test cross and back cross
5. Experiments on epistatic interactions including test cross and back cross
6. Determination of linkage and cross-over analysis (through two point test cross data),
7. Study on sex linked inheritance in Drosophila.

Suggested readings

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

SGPB 222. BASICS OF PLANT BREEDING 3(2+1)

OBJECTIVES

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

THEORY

UNIT I: Historical development, concept, nature and role of plant breeding, major achievements and future prospects; Genetics in relation to plant breeding, modes of reproduction and apomixes, self- incompatibility and male-sterility-genetic consequences,

cultivar options, Plant genetic resources, its utilization and conservation Domestication, Acclimatization and Introduction. Centres of origin/diversity, Components of Genetic variation. Heritability and genetic advance.

UNIT II: Pre-breeding and Universal Plant Breeder's equation. Genetic basis and breeding methods in self-pollinated crops- mass and pure line selection, hybridization techniques and handling of segregating population. Multiline concept, Concepts of population genetics and Hardy-Weinberg Law.

UNIT III: 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.

UNIT IV: Breeding methods in asexually propagated crops, clonal selection and hybridization. Wide hybridization and pre-breeding. Polyploidy in relation to plant breeding, mutation breeding- methods and uses. Breeding for important biotic and abiotic stresses. Participatory plant breeding. Variety Release and notification. Intellectual Property Rights, Patenting, Plant Breeders and Farmer's Rights.

LIST OF EXPERIMENTS/ PRACTICES

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

Suggested Readings

1. Principles of Plant Breeding (1st&2ndEdition) 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.

SGPB 313. CROP IMPROVEMENT (KHARIF CROPS) – I 2(1+1)

OBJECTIVES

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

THEORY

UNIT I: Centres of origin, distribution of species, wild relatives in different cereals; pulses; oilseeds; fibres; fodders and cash crops; vegetable and other horticultural crops of kharif season.

UNIT II: 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.

UNIT III: 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).

UNIT IV: Hybrid seed production technology in maize, rice, sorghum, pearl millet and pigeopea etc. Ideotype concept, climate resilient crop varieties for future.

LIST OF EXPERIMENTS/ PRACTICES

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

2. Maintenance breeding of different kharif crops. Handling of germplasm and segregating populations by different methods like pedigree, bulk and single seed decent methods.

3. Study of field techniques for seed production and hybrid seed production in kharif crops.

4. Estimation of heterosis, inbreeding depression and heritability.

5. Layout of field experiments; Study of quality characters, donor parents for different characters; Visit to seed production plots.

6. Visit to AICRP breeding plots of different crops.

Suggested Readings

1. Breeding field crops-I byV.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 HarRam
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 manual son Crop Improvement I (*Kharif* crops) by Rajendra KumarYadav

SGPB 324. CROP IMPROVEMENT (RABI CROPS) - II 2(1+1)

OBJECTIVES:

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

THEORY

UNIT I: Centres of origin, distribution of species, wild relatives in different cereals; pulses; oilseeds; fibres; fodders and cash crops; vegetable and other horticultural crops.

UNIT II: 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.

UNIT III: 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)

UNIT IV: Hybrid seed production technology in wheat, oat, chickpea, rapeseed and mustard etc. Ideotype concept, climate resilient crop varieties for future.

LIST OF EXPERIMENTS/ PRACTICES

1. Botany of crops.

2. Floral biology.

3. Emasculation and hybridization techniques in different crop species, viz. wheat, oat, rapeseed and mustard.

4. Pulses, potato, sugarcane, tomato, chilli, onion

5. Study of field techniques for seed production and hybrid seed production in rabi crops;

6. Estimation of heterosis, inbreeding depression and heritability;

7. Study of quality characters, donor parents for different characters;

8. 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 HarRam
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

SGPB 325. FUNDAMENTALS OF SEED SCIENCE AND TECHNOLOGY 2(1+1)

OBJECTIVES

1. To impart basic and fundamental knowledge on principles and practices seed science and technology

2. To impart practical skills on scientific seed production and post-harvest quality management

THEORY

UNIT I: 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.

UNIT II: Foundation and certified seed production of important cereals, pulses and oilseed, field inspection, importance and procedures.

UNIT III: 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.

UNIT IV: Seed Certification and legislation; Seed Act and Seed Act enforcement, duty and powers of seed inspector, offences and penalties. Seeds Control Order 1983, basics of seed quality testing; New Seed Bill 2019; Seed quality enhancement techniques.

LIST OF EXPERIMENTS/ PRACTICES

- 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. and Bhale, M.S. 2019. Seed Technology (2nd revised & enlarged edn), Scientific Publishers,ISBN:978-81-72338-84-8, New Pali Road,P.O. Box 91,Jodhpur, India

3. Vanangamudi, K. 2014. Seed Technology (An illustrated book), New India Publishing Agency, New Delhi, India.

4. Bhojwani, S.S. and Bhatnagar, S.P.1999. The Embryology of Angiosperm. Vikas Publ

5. McDonald, M.B. Jrand Copeland, L.O.1997. Seed Production: Principles and Practices. Chapman & Hall.

6. Tunwar, N.S. and Singh, S.N. 1988. Indian Minimum Seed Certification Standards. CSCB, Ministry of Agriculture, New Delhi.

AGRICULTURAL ENTOMOLOGY

SAET121. FUNDAMENTALS OF ENTOMOLOGY 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 insect and their importance for

classification of insects

3. To get an idea about the different physiological systems of insects and their roles in growth and development and communications of insects

4. To study the characteristics of commonly observed insect orders and their economically important families

THEORY

UNIT-I: History of Entomology in India. Major points related to dominance of Insects in Animal kingdom. Classification of phylum Arthropoda up to classes. Relationship of class Insects with other classes of Arthropoda. Morphology: Structure and functions of insect cuticle and molting. Body segmentation. Structure of head,thorax and abdomen. Structure and modifications of insect antennae, mouth parts, legs, Wing venation, modifications and wing coupling apparatus. Metamorphosis and diapause in insects. Types of larvae and pupae.

UNIT-II: Structure and functions of digestive, circulatory, excretory, respiratory, nervous, secretary (Endocrine) and reproductive system, in insects. Types of reproduction in insects. Major sensory organs. Insect Ecology: Introduction, Environment and its components. Effect of abiotic factors and biotic factors. Categories of pests.

UNIT-III: Systematics: Taxonomy – importance, history and development and binomial nomenclature.DefinitionsofBiotype,Sub-species,Species,Genus,FamilyandOrder.Classification of class Insecta up to Orders, basic groups of present day insects with special emphasis to orders and families of Agricultural importance like Orthoptera: Acrididae, Tettigoniidae, Gryllidae, Gryllotalpidae; Dictyoptera: Mantidae, Blattidae; Odonata; Isoptera: Termitidae; Thysanoptera: Thripidae;

UNIT-IV: Hemiptera: Pentatomidae, Coreidae, Cimicidae, Pyrrhocoridae, Lygaeidae, Cicadellidae, Delphacidae, Aphididae, Coccidae, Lophophidae, Aleurodidae, Pseudococcidae; Neuroptera: Chrysopidae; Lepidoptera: Pieridae, Papiloinidae, Noctuidae, Sphingidae, Pyralidae, Gelechiidae, Arctiidae, Saturnidae, Bombycidae; Coleoptera: Coccinellidae, Chrysomelidae, Cerambycidae, Curculionidae, Bruchidae, Scarabaeidae; Hymenoptera: Tenthridinidae, Apidae. Trichogrammatidae, lchneumonidae, Braconidae, Chalcididae; Diptera: Cecidomyiidae, Tachinidae, Agromyziidae, Culicidae, Muscidae, Tephritidae.

LIST OF EXPERIMENTS/PRACTICES

- Methods of collection and preservation of insects including immature stages; External features of Grasshopper/Blister beetle;

- Types of insect antennae, mouthparts and legs; Wing venation, types of wings and wing coupling apparatus.
- Types of insect larvae and pupae; Dissection of digestive system in insects (Grasshopper);
- Study of characters of orders Orthoptera, Dictyoptera, Odonata, Isoptera, Thysanoptera
- Study of characters of orders Hemiptera, Lepidoptera, Neuroptera
- Study of characters of orders Coleoptera, Hymenoptera, Diptera and their families of agricultural importance
- Insecticides and their formulations.
- Pesticide appliances and their maintenance. Sampling techniques for estimation of insect population and damage.

Suggested readings

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

SENT 313. PEST MANAGEMENT IN CROPS AND STORED GRAINS 3(2+1)

OBJECTIVES

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

THEORY

UNIT-I: 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.

UNIT-II: Structural entomology and important house hold 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.

UNIT-III: Storage structures and methods of grain storage and fundamental principles of stored grains management. Management of non insect pest of mites, snails and slugs.

UNIT-IV: Concept of IPM, Practices, scope and limitations of IPM. Classification of insecticides, toxicity of insecticides and formulations of insecticides, Biorational pesticides including insect repellents, anti feed ants, Use of drones and AI in pest management,

LIST OF EXPERIMENTS/PRACTICES

- 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 *insitu*. Management strategies of insect pests of different crops.
- Study on structural entomology and household pests.
- Storage structures and methods of grain storage.
- Spraying techniques for selected field and horticultural crops.
- Vertebrate pest management, Mass multiplication of NPV and entomopathogenic nematodes.

Suggested readings

1. A Text book of Insect Pest and Disease Management,2021. Somnath Sen,and Mohd. Sameer, S. Kataria & Sons publish.
2. Agricultural Pests of India and Southeast Asia, A.S. Athwal, Kalyani Publishers.
3. A Textbook of Applied Entomology, K.P. Srivastava and G.S. Dhaliwal, Kalyani Publish.
4. Integrated pest Management Concept and Approaches-G.S. Dhaliwal and Ramesh Arora

PLANT PATHOLOGY

SPAT 121. FUNDAMENTALS OF PLANT PATHOLOGY 3(2+1)

OBJECTIVES

1. To get acquainted with the role of different microorganisms in the development of plant disease

2. To get general concepts and classification of plant diseases

3. To get knowledge of general characteristics of fungi, bacteria, virus, and other 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

UNIT I: 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;

UNIT II: 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

UNIT III: 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;

UNIT IV: Principles of Plant disease management: Disease management with chemicals, Host resistance, cultural and biological method of Integrated Disease Management (IDM).

LIST OF EXPERIMENTS/PRACTICES

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

Suggested readings

1. Agrios, G.N. 2010. Plant Pathology. Acad. Press.
2. A lexopoulos, Mims and Blackwel. Introductory Mycology.
3. Dhingra, O.D. and Sinclair, J.B. 1986. Basic Plant Pathology Methods. CRC Press, London, Tokyo.
4. Gibbs,A. and Harrison, B.1976.Plant Virology-The Principles. Edward Arnold, London
5. Goto, M.1990. Fundamentals of Plant Bacteriology. Academic Press, New York.
6. HullR.2002.Mathew's Plant Virology.4th edn. Academic Press, NewYork.
7. Kamat, M.N. Introductory Plant Pathology. Prakash Pub, Jaipur.
8. Mehrotra ,R.S. and Aggarwal, A. 2007. Plant Pathology. 7th edn.Tata Mc Graw HillPubl. Co. Ltd.

9. Nene,Y.L.and Thapliyal, P.N.1993. Fungicides in Plant Disease Control. 3rd Ed. Oxford & IBH, New Delhi.

10. Pathak, V.N. Essentials of Plant Pathology. Prakash Pub., Jaipur

11. Rajeev, K. and Mukherjee, R. C. 1996. Role of Plant Quarantine in IPM. Aditya Books.

12. Rhower, G.G.1991.Regulatory Plant Pest Management. In: Hand book of Pest Management in Agriculture. 2ndedn. Vol. II. (Ed. David Pimental). CRC Press.

13. Singh R.S. 2008. Plant Diseases. 8th Ed. Oxford & IBH. Pub.Co.

14. Singh R.S.2013. Introduction to Principles of Plant Pathology. Oxford and IBH Pub.Co.

15. Verma, J.P. 1998. The Bacteria. Malhotra Publ. House, New Delhi.

16. VyasSC.1993.Handbook of Systemic Fungicides. Vols.I-III.TataMc GrawHill, New Delhi.

SPAT 312.DISEASES OF FIELD AND HORTICULTURAL CROPS AND THEIR MANAGEMENT 3(2+1)

OBJECTIVES

1. To study the symptoms produced on the host

2. To study the etiology of the diseases

3. To know about the disease cycle of the pathogens during pathogenesis

4. To study the epidemiological factors responsible for disease development

5. To study the management techniques for curbing the major diseases of field and horticultural crops

THEORY

UNIT I: Symptoms, etiology, disease cycle, epidemiology and management of major diseases of thefollowing field and horticultural crops: Field crops- Rice (blast, brown spot, sheath blight, falsesmut, 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)

UNIT II: 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, Pokah Boeng); Mustard (Alternaria blight, white rust, downy mildew,

sclerotinia stem rot) and Sunflower (sclerotinia stem rot, Alternaria blight); Cotton (anthracnose, vascular wilts, blackarm).

UNIT III: Horticultural crops: Citrus (canker, gummosis) and Guava (wilt, anthracnose); Banana (sigatoka, Panama wilt, bacterial wilt, bunchy top); Papaya (foot rot, leaf curl, mosaic) and Pomegranate (bacterial blight); Apple (scab, powdery mildew, fire blight, crown gall) and Peach (leaf curl); Grapevine (downy mildew, powdery mildew, anthracnose) and Strawberry(leaf spot); Coconut (bud rot, Ganoderma wilt), Tea (blister blight) and Coffee (rust); Mango(anthracnose, malformation, bacterial blight, powdery mildew);

UNIT IV: Potato (early and late blight, black scurf, leaf roll, mosaic) and Tomato (damping off, wilt, early and late blight, leaf curlmosaic); 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).

LIST OF EXPERIMENTS/PRACTICES

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

Suggested Readings

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

SPAT 323. AGRICULTURAL MICROBIOLOGY AND PHYTO-REMEDIATION 2(1+1)

OBJECTIVES

1. To get an introduction to microbiology with specific focus on its significance in agriculture science

2. To get acquainted with the bacterial structure and the function of the different bacterial Components.

3. To get highlights on different fields of microbiology.

4. To get highlights on the bioremediation of polluted soils using microbial mediators and phytoremediation

5. To get a concept of biological control and the role of biopesticides in plant disease management.

THEORY

UNIT I: 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.

UNIT II: Soil Microbiology: Nutrient mineralization and transformation, Air Microbiology: Phyllosphere microflora, Phylloplane microflora, microflora of floral parts etc. Food Microbiology: Microbial spoilage and principles of food preservations, Food poisoning. Water Microbiology:

UNIT III: Types ofwater, water microorganisms, and microbial analysis of water e.g. coliform test, Purificationof water. Industrial Microbiology: Microbial products, Biodegradation, Biogas production, Biodegradable plastics etc. Biological control:

Microbial biopesticides for plant disease management Concepts of rhizosphere microbiology- Rhizodeposits -biochemical nature, release mechanism in rhizosphere, function, Carbon flow in rhizosphere, Rhizosphere microbiome-residents and their roles.

UNIT IV: 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.

LIST OF EXPERIMENTS/PRACTICES

- Study of the microscope.
- Acquaintance with laboratory material and equipment;
- Microscopic observation of different groups of microorganisms: moulds (Fungi); Direct staining of bacteria by crystal violet; Negative or indirect staining of bacteria by nigrosin; Gram staining of bacteria;
- Study of phyllosphere and rhizosphere microflora; Measurement of microorganisms;
- Preparation of culture media;
- Isolation and purification of rhizospheric microbes;
- Isolation and purification of N-fixers;
- Isolation and purification of Nutrient solubilizers;
- Isolation and purification of Endophytes.

Suggested readings

1. Pelczar, M.J., Chan, E.C.S. and Kreig, N.R. 2002. Microbiology. 5th Edition, Tata Mc Graw-Hill, New Delhi.

2. Rangaswami, G. and Bagyaraj, D.J.2005.Agricultural Microbiology. Prentice-Hall of India Pvt. Ltd., New Delhi.

3. Mukherjee, N.and Ghosh,T. 2004. Agricultural Microbiology. Kalyani Publishers, Calcutta.

4. Dubey, H.C.2007.A Text book of Fungi, Bacteria and Viruses. Vikas Publishing House Ltd., New Delhi – 10014

5. Salyers, A. A. and Whitt, D. D.2001.Microbiology: diversity, disease, and the environment.

6. Fitzgerald Science Press, Inc.

7. Prescott, L.M. 2002. Microbiology 5th Edition. McGraw-HillInc, US

AGRICULTURAL EXTENSION

SAEX. 111. 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

UNIT I: 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 and Agricultural Extension. Indian Rural Society: important characteristics, differences and relationship between rural and urban societies. Social Groups: Meaning, definition, classification, factors considered information and organization of groups, motivation in group formation and role of social groups in Agricultural Extension.

UNIT II: Social Stratification: Meaning, definition, functions, basis for stratification, forms of social stratification- characteristics and- differences between class and caste system. Cultural concepts: culture, customs, folkways, mores, taboos, rituals. Traditions: Meaning, definition and their role in Agricultural Extension. Social Values and Attitudes: Meaning, definition, types and role of social values and attitudes in agricultural Extension. Social Institutions: Meaning, definition, major institutions in rural society, functions, and their role in agricultural Extension.

UNIT III: 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.

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

SAEX 122. PERSONALITY DEVELOPMENT 2(1+1)

OBJECTIVE

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

THEORY

UNIT I: 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,

UNIT II: 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,

UNIT III: 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,

UNIT IV: 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.

LIST OF EXPERIMENTS/PRACTICES

- 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. Artof Public Speaking. New Delhi.Tata-Mc-GrawHill.
5. Mile, D.J.2004.Power of Positive Thinking. Delhi. Rohan Book Company.
6. Pravesh Kumar. 2005. All about Self-Motivation. New Delhi. Good will Publishing House.
7. Smith, B. 2004. Body Language. Delhi: Rohan Book Company.
8. Shaffer, D.R. 2009. Social and Personality Development (6^{th} Edition).Belmont, CA: Wadswor.

SAEX 214. ENTREPRENEURSHIP DEVELOPMENT AND BUSINESS 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 agri business proposal

THEORY

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

UNIT II: 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.

UNIT III: 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. Persona management–manpower planning, labour turn over, wages / salaries.

UNIT IV: 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.

LIST OF EXPERIMENTS/PRACTICES

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

Suggested Readings

1. Charantimath, P.M. 2009, Entrepreneurship Development and Small Business Enterprises. Pearson Publications, New Delhi.
2. Desai, V. 2015, Entrepreneurship: Development and Management, Himalaya Publishing House.
3. Gupta, C.B. 2001. Management Theory and Practice. Sultan Chand & Sons.
4. Indu Grover. 2008. Hand book on Empowerment and Entrepreneurship. Agrotech Public Academy.
5. Khanka, S.S. 1999. Entrepreneurial Development. S. Chand & Co.
6. Mehra, P.2016, Business Communication for Managers. Pearson India, New Delhi.

7. Pandey, M. and Tewari, D. 2010, The Agribusiness Book. I B D C Publishers, Lucknow.
8. Singh,D. 1995. Effective Managerial Leadership. Deep & DeepPubl.
9. Singhal, R.K. 2013, Entrepreneurship Development & Management, Katson Books.
10. Tripathi,P.C. and Reddy, P.N. 1991. Principles of Management. Tata Mc GrawHill.
11. Vasant Desai,1997. Small Scale Industries and Entrepreneurship. Himalaya Publ. House.

SAEX 213. FUNDAMENTALS OF EXTENSION EDUCATION 2(1+1)

OBJECTIVES

1. State the importance of extension education in agriculture
2. Familiarize with the different types of agriculture and rural development programs 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

UNIT I: Education: Meaning, definition and Types; Extension Education: meaning, definition, scope and process; objectives and principles of Extension Education; Extension Programme planning: Meaning, Process, Principles and Steps in Programme Development. Extension systems in India: extension efforts in pre-independence era (Sriniketan, Marthandam, Firka Development Scheme, Gurga on Experiment, etc.)and post-independence era (Etawah Pilot Project, Nilokheri Experiment, etc.); Reorganised Extension System (T&V system) various extension/ agriculture development programs launched by ICAR/Govt. of India (IADP, IAAP, HYVP, KVK, IVLP, ORP, ND, NATP, NAIP, etc.).

UNIT II: Social Justice and poverty alleviation programme: ITDA, IRDP/SGSY/NRLM. Women Development Programme: RMK, MSY etc. New trends in agriculture extension: privatization extension, cyber extension/ e-extension, market-led extension, farmer-led extension, expert systems, etc., Attributes of Innovation, DWCRA, Commodity Interest Groups (CIGs)., Farmers Producer Group (FPG).

UNIT III: Rural Development: concept, meaning, definition; various rural development programs launched by Govt. of India. Community Development: meaning, definition, concept and principles, Philosophy of C.D. Rural Leadership: concept and definition, types of leaders in rural context; Method of identification of Rural Leader.

UNIT IV: Extension administration: meaning and concept, principles and functions. Monitoring and evaluation: concept and definition, monitoring and evaluation of extension programs; transfer of technology: concept and models, capacity building of extension personnel; extension teaching methods: meaning, classification, individual, group and mass contact methods, ICT Applications in TOT (New and Social Media), media mix strategies; communication: meaning and definition; Principles and Function s of Communication, models and barriers to communication. Agriculture journalism; diffusion and adoption of innovation: concept and meaning, process and stages of adoption, adopter categories.

LIST OF EXPERIMENTS/PRACTICES

- 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 Lakshmipress, Bapatla.

2. Dahama, O. P. and Bhatnagar, O.P. 1998. Education and Communication for Development, Oxford and IBH publishing Co. Pvt. Ltd, New Delhi.

3. Jalihal,K.A. and Veerabhadraiah,V.2007. Fundamentals of Extension Education and

Management in Extension, Concept publishing company, New Delhi.

4. Muthaiah Manoraharan, P. And Arunachalam, R., Agricultural Extension, Himalaya Publishing House (Mumbai).

5. Sagar Mondal and Ray, G.L., Text Book on Rural Development, Entrepreneurship and Communication Skills, Kalyani Publications.

6. Rathore, O.S. *et al*., 2012. Hand book of Extension Education, Agrotech Publishing Academy, Udaipur.

7. Dudhani, C.M., Hirevenkat goudar, L.V., Manjunath, L.Hanchinal, S.N. and Patil,S.L. 2004. Extension Teaching Methods and Communication Technology, UAS, Dharwad.

AGRICULTURAL METEOROLOGY

SAMT 312. INTRODUCTORY AGRO FORESTRY 2 (1+1)

OBJECTIVES

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

THEORY

UNIT I Agro-forestry: Definition and scope of Agroforestry system, Type of Agroforestry system, potential of Agroforestry in India, Prevailing agroforestry system in India; MPTS-definition, role of MPTS in agroforestry system, its selection for different agroforestry system, MPTS of India, Ecological aspects of Agroforestry system, tree -crop interaction – competition, nutrient recycling;

UNIT II Traditional Agroforestry as a viable choice to conserve Agro biodiversity of India. Management of Agro-forestry system; Role of agroforestry in soil and water conservation; windbreak; Shelterbelt– definition, objectives.; Socio- economic aspects of Agroforestry system;

UNIT III Design and Diagnostic study of agroforetry system; Silviculture: Definition and scope, Propagation of tree species, Regeneration by seed, coppice, root suckers, Transplanting, stump, branch cutting, rhizomes; Nursery bed preparation and management; Cultural practices for bare root and seedling, field handling of nursery stock; Management of tree species;

UNIT IV Silviculture of important tree species, choice of species- site factors, root, crown and bole characteristics, phenology, nutritional and water requirement, ground operation, tending, harvesting utility etc. Horticulture and forage crops-based agroforestry models developed by ICAR-IGFRI; Agroforestry models developed by Indian council of Forestry Research and Education.

LIST OF EXPERIMENTS/ PRACTICES

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

Suggested readings

1. Nair,P.K.R.1993.An Introduction to Agro forestry, Kluar Academic Publisher
2. Chundawat D.S. and S.K. Gautham. 2017. Text book of Agro forestry. Oxford & IBH Publishing, (ISBN: 9788120408326)
3. Parthiban, K.T,N. Krishna kumar and M.Karthick.2018. Introduction to Forestry, Scientific Publisher, Jodhpur. 350p

SAMT 121. 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:

UNIT I: 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.

UNIT II: 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. Bio-geographical classification of India. Importance and Value of biodiversity. Biodiversity hot spots. Threats and Conservation of biodiversity.

UNIT III: 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, rainwater harvesting, and watershed management. Environmental ethics: Issues and possible solutions, climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust.

UNIT IV: 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.

LIST OF EXPERIMENTS/ PRACTICES

1. Visit to a local area to document environmental assets river/ forest/ grassland/ hill/ mountain.
2. Energy: Biogas production from organic wastes.
3. Visit to wind mill / hydro power / solar power generation units.
4. Biodiversity assessment in farming system. Floral and faunal diversity assessment in polluted and unpolluted system.

5. Visit to local polluted site - Urban/Rural/Industrial/Agricultural to study of common plants, insects and birds.
6. Environmental sampling and preservation.
7. Water quality analysis: pH, EC and TDS.
8. Estimation of Acidity, Alkalinity.
9. Estimation of water hardness.
10. Estimation of DO and BOD in water samples.
11. Estimation of COD in water samples.
12. Enumeration of *E. coli* in water sample.
13. Assessment of Suspended Particulate Matter (SPM).
14. Study of simple ecosystem – Visit to pond/ river/ hills.
15. Visit to areas affected by natural disaster.

Suggested Readings

1. De, A.K. 2010. Environmental chemistry. Published by New Age International Publishers, NewDelhi.ISBN:13–9788122426175.384pp
2. Dhar Chakrabarti, P.G.2011. Disaster management-India's risk management policy frameworks and key challenges. Published by Centre for Social Markets (India), Bangalore.36pp.
3. Erach Bharucha, Text book for Environmental studies. University Grants Commission, New Delhi
4. Parthiban, K.T., Vennila, S., Prasanthrajan, M. Umesh and Kanna, S. 2023. Forest, Environment, Biodiversity and Sustainable development. Narendra Publishing House, New Delhi
5. Prasanthrajan, M. and Mahendran, P.P. 2008. A text book on Ecology and Environmental Science. ISBN81-8321-104-6. 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.

AGRICULTURAL ECONOMICS

SAEC 221. PRINCIPLES OF AGRICULTURAL ECONOMICS AND FARM MANAGEMENT 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

UNIT I: 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 to equilibrium, economical as generalization of human behavior. Basic concepts: Goods and services, desire, want, demand, utility, cost and price, wealth, capital, income and welfare.

UNIT II: 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.

UNIT III: 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 runcost 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.

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

SAEC 312. AGRICULTURAL MARKETING AND TRADE 3 (2+1)

OBJECTIVES

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

THEORY

UNIT I: 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).

UNIT II: Market functionaries and marketing channels: Types and importance of agencies involved in agricultural marketing; meaning and definition of marketing channel; number of channel levels; marketing channels for different farm products; Integration, efficiency, costs and price spread: Meaning, definition and types of market integration; marketing efficiency;

marketing costs, margins and price spread; factors affecting cost of marketing; reasons for higher marketing costs of farm commodities; ways of reducing marketing costs;

UNIT III: Role of Govt. in agricultural marketing: Public sector institutions- CWC, SWC, FCI, CACP and DMI – their objectives and functions; cooperative marketing in India; Risk in marketing: Types of risk in marketing; speculation and hedging; an overview of futures trading; Agricultural prices and policy: Meaning and functions of price; administered prices; need for innovations in agricultural price policy;

UNIT IV: 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.

LIST OF EXPERIMENTS/PRACTICES

- Study of demand and supply curves
- Calculation of elasticity
- Study of relationship between market arrivals and prices of some selected commodities;
- Computation of marketable and marketed surplus of important commodities;
- Construction of index numbers;
- 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;
- Time series analysis
- Visit to marketing institutions.
- 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, New Delhi.

3. Dominic Salvatore, Micro Economic Theory.

4. Kohls Richard, L. and Uhl Josheph, N., 2002, Marketing of Agricultural Products. Prentice- Hall of India Private Ltd., New Delhi.

5. Kotler and Armstrong, 2005, Principles of Marketing. Pearson Prentice-Hall.

6. Lekhi, R.K. and 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.

SAEC 323. AGRICULTURAL FINANCE AND COOPERATION 2(1+1)

OBJECTIVES

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

THEORY

UNIT I: 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 non-institutional sources, commercial banks, social control and nationalization of commercial banks. Micro financing including KCC. Lead bank scheme, RRBs, Scale of finance and unit cost.

UNIT II: 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.

UNIT III: 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, 5C's and 7P'sofcredit.

UNIT IV: 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.

LIST OF EXPERIMENTS/PRACTICES

- Optimum allocation of limited amount of capital among different enterprise.
- Analysis of progress and performance of cooperatives using published data.
- Analysis of progress and performance of commercial banks and RRBs using published data.
- Visit to a commercial bank, cooperative bank and cooperative society to acquire first-hand knowledge of their management, schemes and procedures.
- Estimation of credit requirement of farm business – A case study.
- Preparation and analysis of balance sheet – A case study.
- Preparation and analysis of income statement – A case study.
- Appraisal of a loan proposal – A case study.
- Techno-economic parameters for preparation of projects.
- Preparation of Bankable projects for various agricultural products and its value-added products.
- Seminar on selected topics.
- Different types of repayment plans.

Suggested readings

1. Gittinger, J.P. 1982. Economic Analysis of Agricultural Projects. The Johns Hopkins Univ. Press.

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

AGRICULTURE STATISTICS

SMAT 111. INTRODUCTORY MATHEMATICS 1(1+0)

THEORY

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

UNIT II: Differential Calculus: Definition-Differentiation of function using first principle, Derivatives of sum, difference, product and quotient of two functions, Methods, Increasing and Decreasing Functions.

UNIT III: Application of Differentiation- Growth rate, Average Cost, and Marginal cost, Marginal Cost, Marginal Revenue. Partial differentiation: Homogeneous function, Euler's theorem, Maxima and Minima of the functions of the form y = f (x) and y = f (x1, x2).

UNIT IV: Integral Calculus: Integration -Definite and Indefinite Integrals-Methods-Integration by substitution, Integration by parts. Area under simple well-known curves. Mathematical Models: Agricultural systems - Mathematical models - classification of mathematical models- Fitting of Linear, quadratic and exponential models to experimental data.

SAEG 221. AGRICULTURAL INFORMATICS AND ARTIFICIAL INTELLIGENCE 3(2+1)

OBJECTIVES:

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:

UNIT I: 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.

UNIT II: 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

map ping 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.

UNIT III: 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.

UNIT IV: 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 is planning and crop calendars using IT tools, Digital India and schemes to promote digitalization of agriculture in India.

LIST OF EXPERIMENTS/PRACTICES

1. Study of computer components, accessories, practice of important DoS Commands, Introduction of different operating systems such as Windows, Unix / Linux, creating files and folders, File Management. Use of MS-WoRD and MS Power-point for creating, editing and presenting a scientific documents, MS- EXCEL - Creating a spreadsheet, Use of statistical tools, writing expressions, Creating graphs, Analysis, macros.
2. MS-ACCESS: Creating Database, preparing queries and reports, Demonstration of Agri.-information system.
3. Introduction to World Wide Web (WWW) and its components.
4. 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,
5. Preparation of inputs file for CSM and study of model outputs, computation of water and nutrient requirements of crop using CSM and IT tools.
6. Use of smart phones and other devices in agro-advisory and dissemination of market information.
7. Introduction of Geospatial Technology, Hands on practice on preparation of Decision

Support System, Preparation of contingent crop planning.

8. 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 Ketal, Jain Brothers Publication.
6. Russell, Stuart, Artificial Intelligence: A Modern Approach, Pearson Edition 2013.
7. Nilson N.J.2001. Principles of Artificial Intelligence. Narosa.

SAST 321. BASIC AND APPLIED AGRICULTURAL STATISTICS 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

UNIT I: 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.

UNIT II: 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-efficient of Dispersions. Co-efficient of Variation.

UNIT III: 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.

UNIT IV: Regression Equations. Regression Coefficients. Properties of Regression Coefficients. Tests of Significance. Definition. Null and Alternative Hypothesis. Type I and Type II Error. Critical Region and Level of Significance. One Tailed and Two Tailed Tests. Test Statistic. One Sample, Two Sample and Paired t-test with Examples. F-test for Variance. ANOVA and Experimental Designs. Definition of ANOVA. Assignable and Non assignable Factors. Analysis of One-way Classified Data. Basic Examples of Experimental Designs. Terminologies. Completely Randomized Design (CRD). Sampling Theory. Introduction. Definition of Population, Sample, Parameter and Statistic. Sampling Vs Complete Enumeration. Sampling Methods. Simple Random Sampling with Replacement and without Replacement. Use of Random Number Table.

LIST OF EXPERIMENTS/PRACTICES

- 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. Guptaand, 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.

AGRICULTURE ENGENERING

SAEG 222. FARM MACHINERY AND POWER 2(1+1)

OBJECTIVES

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

THEORY

UNIT I: Status of Farm Power in India; Sources of Farm Power, I.C. engines, working principles of IC engines; comparison of two stroke and four stroke cycle engines, Study of different components of I.C. engine.

UNIT II: 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.

UNIT III: 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

UNIT IV: 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.

LIST OF EXPERIMENTS/PRACTICES

- Study of different components of I.C. engine.
- To study air cleaning and cooling system of engine.
- Familiarization with clutch, transmission, differential and final drive of a tractor.
- Familiarization with lubrication and fuel supply system of engine.
- Familiarization with brake, steering, hydraulic control system of engine.
- Learning of tractor driving.
- Familiarization with operation of power tiller.
- Implements for hill agriculture.
- Familiarization with different types of primary and secondary tillage implements: mould plough, disc plough and disc harrow.
- Familiarization with seed-cum-fertilizer drills their seed metering mechanism and calibration, planters and trans planter.
- Familiarization with different types of sprayers and dusters.
- Familiarization with different inter-cultivation equipment.
- Familiarization with harvesting and threshing machinery.
- Calculation of power requirement for different implements.

Suggested readings

1. Jagdiswar Sahay–Elements of Agricultural Engineering
2. Jain, S.C. and C.R. Rai-Farm Tractor and maintenance and repair. Standard Publishers, 1705-B, Naisarak. Delhi- 110006

SAEG 323. RENEWABLE ENERGY IN AGRICULTURE AND ALLIED SECTOR 2(1+1)

OBJECTIVES

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

THEORY

UNIT I: Classification of energy sources, contribution of these of sources in agricultural sector; Familiarization with biomass utilization for biofuel production and their application;

UNIT II: Familiarization with types of biogas plants and gasifiers, biogas, bio alcohol, biodiesel and bio oil production and their utilization as bio energy resource.

UNIT III: Introduction of solar energy, collection and their application; Familiarization with solar energy gadgets: solar cooker, solar water heater, application of solar energy: solar drying, solar pond, solar distillation, solar photovoltaic system and their application;

UNIT IV: Introduction of wind energy and their application. Availability of biomass and their application in different places.

LIST OF EXPERIMENTS/PRACTICES

- Familiarization with renewable energy gadgets.
- To study biogas plants
- Study of gasifier
- Production process of biodiesel
- Briquetting machine and Production process of bio-fuels.
- Familiarization with different solar energy gadgets.
- To study solar photo voltaic system: solar light, solar pumping, solar fencing, solar cooker and solar drying system.
- To study solar distillation, solar pond and solar wind hybrid system.
- Field visit to Solar –Wind farm.

Suggested readings

1. C.S. Solanki. 2011. Solar Photovoltaic – Fundamentals, Technologies and Applications. PHI Learning Pvt. Ltd.
2. S. Sukhatme and J. Nayak. 2008. Solar Energy: Principles of Thermal Collection and Storage. Third Edition (Tata McGraw-Hill).

NEMATOLOGY

SENT 212. FUNDAMENTALS OF NEMATOLOGY 2(1+1)

OBJECTIVES

1. To impart knowledge on history, economic importance of plant parasitic nematodes, morphology, biology, host parasitic relationship of nematodes.
2. To impart knowledge on nematode pests of different crops of national and local importance and their management.

THEORY

UNIT I Introduction: History of phytonematology, habitat and diversity, economic importance of nematodes. General characteristics of plant parasitic nematodes. Nematode: definition, general morphology and biology.

UNIT II: Classification of nematodes up to family level with emphasis on groups containing economically important genera. Classification of nematodes on the basis of feeding/ parasitic habit. Symptomatology, role of nematodes in disease development

UNIT III: 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.

UNIT IV: Different methods of nematode management: Cultural methods, physical; methods, Biological methods, Chemical methods, Plant Quarantine, Plant resistance and INM.

LIST OF EXPERIMENTS/PRACTICES

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

Suggested readings

1. Economic Nematology-Edited by J.M. Webster
2. Text book on Introductory Plant Nematology- R.K. Walia and H. K. Bajaj.

BIOCHEMISTRY

SBCH 321: ESSENTIALS OF PLANT BIOCHEMISTRY 3(2+1)

OBJECTIVE

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

THEORY

UNIT-I Biochemistry–Introduction and importance, Properties of water, Ph and buffer, plant cell and its components. Bio-molecules–Structure, classification, properties and function of carbohydrates, amino acids, proteins, lipids and nucleic acids.

UNIT-II Vitamins – physiological and metabolic role. Enzymes: General properties; Classification; Mechanismo faction; Michael is and Menten and Line Weaver Burk equation and plots; Introduction to allosteric enzymes, use of enzymes.

UNIT-III Metabolic energy and its generation – Metabolism – Basic concepts, Glycolysis, Citric acid Cycle, Pentose phosphate pathway, oxidative phosphorylation, Fatty acid oxidation.

UNIT-IV Biosynthetic Pathways – Photosynthesis, Gluconeogenesis, nitrogen fixation, fatty acid and starch formation. Regulation of metabolic pathways. Secondary metabolites, Terpenoids, Alkaloids, Phenolic and their applications in food and pharmaceutical industries.

LIST OF EXPERIMENTS/PRACTICES

- Preparation of standard solutions and reagents
- Determination of pH
- Qualitative tests of carbohydrates and amino acids
- Quantitative estimation of soluble sugars and starch
- Estimation of protein by Kjeldhal method and Lowry's method
- Preparation of mineral solution from ash
- Estimation of fat by Soxhlet method
- Determination of acid value, saponification value and iodine number
- Estimation of ascorbic acid, Qualitative/quantitative tests of secondary metabolites.

Suggested reading

1. Nelson and Cox. 2008. Lehninger Principles of Biochemistry. Fourth/Fifth edition. Freeman (Can be downloaded)
2. Conn,Stumpf,BrueningandDoi.2006.OutlinesofBiochemistry.FifthEdition.Wiley
3. Heldt. 2005. Plant Biochemistry. Elsevier (Can be downloaded)
4. Goodwin and Mercer. 2005. Introduction to Plant Biochemistry. 2nd edition. CBS.

SCPH: 311. FUNDAMENTALS OF CROP PHYSIOLOGY 3 (2+1)

OBJECTIVES

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

THEORY

UNIT I: Definitions of plant physiology and crop physiology; Importance of crop physiology; Relationship of crop physiology with other branches of crop science; Diffusion

and osmosis; Physiological roles of water to crop plants; Definition of water potential and components of water potential; Water absorption by plants: Concept of active and passive absorption; Water loss by plants: Types of water loss: transpiration, stomatal physiology and guttation; Water use efficiency; Essential and beneficial elements; Passive and active transport of mineral element; Functions of essential elements; Criteria of essentiality of nutrients; Correction measures for nutrient deficiency symptoms; Foliar nutrition and root feeding – significance; Aeroponics Imbibition; Field capacity, permanent wilting point and available soil moisture; Apoplast, symplast and transmembrane, Ascent of sap – theories and mechanism; Soil-plant-atmospheric continuum. Significance of transpiration. Stomatal opening and closing mechanisms.

UNIT II: Definition of Cavitation and embolism. Antitranspirants - types and examples. Hydroponics and sand culture. Overview of plant cell – organelle and their functions. Brief outline of: Photosynthetic apparatus, pigment system, quantum requirement and quantum yield; Structure of chloroplast, Examples of different photosynthetic pigments (chlorophyll, carotenoids, phycobilins etc.), Difference between chlorophyll a and chlorophyll b, Structure of chlorophyll a and chlorophyll b, Short discussion on quantum requirement and quantum yield, Red drop and Emerson enhancement effect, Pigment system I and II.

UNIT III: Introduction to light reaction of photosynthesis, Light absorption by photosynthetic pigments and transfer of energy. Source of O_2 during photosynthesis: Hill reaction; Brief introduction to cyclic and non-cyclic photo-phosphorylation: production of assimilatory powers; Introduction to C_3, C_4 and CAM pathways: Calvin Cycle, Hatch and Slack Cycle, CAM Cycle; Significance of these pathways (concept of photorespiration, absence of photorespiration in C_4 plant: Productivity of C_4 plant, CAM: an adaptive mechanism); Factors affecting photosynthesis (light, temperature, CO_2, O_2 etc.). Outline of the process of respiration: Definition and importance, Glycolysis, Kreb Cycle and ETC, Factors affecting respiration (O_2, temperature, CO_2 etc.). Terminologies

UNIT IV: Definitions: Growth, Development and Differentiation. Measurement of plant growth (fresh weight, dry weight, linear imension, area etc.). Introduction to CGR, RGR, NAR etc. Photoperiodism: 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 Abscisic acid) and their major physiological roles, Agricultural uses of PGRs (IBA, NAA, 2.4–D, Gas, Kinetin etc).

LIST OF EXPERIMENTS/PRACTICES

- 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
- Determination of electrical conductivity of soil.
- Identification of nutrients by hydroponics.
- Estimation of photosynthetic pigments, rate of photosynthesis, respiration and transpiration; Plant growth analysis.
- Study on senescence and abscission, hormonal regulation of senescence.
- Demonstration of the effects of different PGRs on plants, Leaf anatomy of C_3 and C_4plants.

Suggested readings

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

ANIMAL HUSBANDRY

SASC.121 LIVESTOCK AND POULTRY MANAGEMENT 2(1+1)

OBJECTIVES

1. Provide basic knowledge to the students about scientific livestock and poultry rearing practices
2. Entrepreneurship development through Livestock/poultry and Agriculture Integrated Farming System

THEORY

UNIT I 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.

UNIT II Management of sheep, goat andswine. Incubation, hatching and brooding. Management of growers and layers. Important Indian and exotic breeds of cattle, buffalo, sheep, goat, swine and poultry.

UNIT III 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.

UNIT IV 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.

LIST OF EXPERIMENTS/PRACTICES

- External body parts of cattle, buffalo, sheep, goat, swine and poultry
- Handling and restraining of livestock
- Identification methods of farm animals and poultry
- Visit to IDF and IPF to study breeds of livestock and poultry and daily routine farm operations and farm records.
- Judging of cattle, buffalo and poultry
- Culling of livestock and poultry
- Planning and layout of housing for different types of livestock
- Computation of rations for livestock
- Formulation of concentrate mixtures
- Clean milk production, milking methods.
- Hatchery operations, incubation and hatching equipment
- Management of chicks, growers and layers
- Debeaking, dusting and vaccination
- Economics of cattle, buffalo, sheep, goat, swine and poultry production.

Suggested Readings

1. A Text book of Animal Husbandry by G.C Banerjee
2. A text Book of Livestock Production management in Tropic by D.N. Verma

SABT 321 FUNDAMENTALS OF AGRICULTURAL BIOTECHNOLOGY 3(2+1)

OBJECTIVES

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

THEORY

UNIT I: Introduction to Plant Tissue Culture and Genetic Engineering: History; Cellular Totipotency and cyto differentiation; Callus culture, Single-cell/suspension culture and their applications; Organogenesis and somatic embryogenesis; Somaclonal variation and its use in crop improvement; Embryo rescue technique and its significance in hybrid development; *In vitro* fertilization, ovule culture and its significance in hybrid development; Protoplast isolation, culture and regeneration; Somatic hybridization (somatic hybrids and cybrids) and its application in crop improvement; Anther and pollen culture for haploid production.

UNIT II: Development of disease-free (virus free) plants through apical meristem culture; Micro-propagation technique for the generation of quality planting material; Synthetic seeds and its applications; National certification and Quality management of TC plants-secondary metabolite production- *in vitro* germ plasm conservation.

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

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

LIST OF EXPERIMENTS/PRACTICES

- Introduction to Plant Tissue Culture Laboratory; Good Laboratory Practices; Media Preparation and sterilization; Glassware sterilization.
- Micro-propagation; Callus induction and culture; Anther culture; Apical meristem culture

- Preparation of synthetic seeds.
- Isolation of plasmid DNA.
- Quantification of DNA; Agarose Gel Electrophoresis and visualization of plasmid DNA.
- Restriction digestion of plasmid DNA and agarose gel electrophoresis;
- Isolation of Plant genomic DNA; PCR amplification of DNA;
- Gel electrophoresis of amplified DNA,
- Visit to tissue culture units/biotech labs.

Suggested readings

1. Bhojwani S S. 1983.Plant Tissue Culture: Theory and Practice. Elsevier.
2. Singh B D.2007. Biotechnology: Expanding Horiozon. Kalyani
3. LewinB. 2008. Gene IX. Peterson Publications/Panima. W.H. Freeman & Co.
4. Primrose S B. 2001. Molecular Biotechnology. Panima.

SEMESTER VII

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

ELECTIVE COURSES

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 CropImprovement
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

ELECTIVE COURSE-1

AGRI-BUSINESS MANAGEMENT 4(3+1)

OBJECTIVES

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

THEORY

UNIT I: 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.

UNIT II: Institutional arrangement, procedures to setup agro based industries. Constraints in establishing agro-based industries. Agri-value chain: Understanding primary and support activities and their linkages. Business environment: PEST and SWOT analysis. Management functions: Roles and activities, Organization culture. Planning, meaning, definition, types of plans. Purpose or mission, goals or objectives, Strategies, polices procedures, rules, programs and budget.

UNIT III Components of a business plan, Steps in planning and implementation. Organization staffing, directing and motivation. Ordering, leading, supervision, communications, control. Capital management and financial management of Agribusiness. Financial statements and their importance. Marketing Management: Segmentation, targeting and positioning.

UNIT IV Marketing mix and marketing strategies. Consumer behaviour analysis, Product Life Cycle (PLC). Sales and Distribution Management. Pricingpolicy, various pricing methods. Project Management definition, project cycle, identification, formulation, appraisal, implementation, monitoring and evaluation. Project Appraisal and evaluation techniques.

LIST OF EXPERIMENTS/PRACTICES

- Study of agri–input markets: Seed, fertilizers pesticides.
- Study of output markets: grains, fruits, vegetables, flowers.
- Study of product market, retails trade commodity trading, and value-added products.
- Study of financing institutions- Cooperative, Commercial Bank, RRBs, Agribusiness Finance Limited, NABARD.
- Preparations of projects and Feasibility reports for agribusiness entrepreneur.
- Appraisal /evaluation techniques of identifying viable project- Non discounting techniques.
- Case study of agro- based industries.
- Trend and growth rate of price of agricultural commodities. Net present worth technique for selection of viable project. Internal rate of return.

Suggested readings

1. Broadway, A.C. and Broadway, Arif, A. 2002. A textbook of Agri-Business Management. Kalyani Publishers

2. Bairwa,S.L.2016.ObjectiveonFundamentalsofAgri-businessManagement.Kalyani Publishers

3. AnjanNishra,DebasishBiswasandArunangshuGiri.2019.AgribusinessManagement,

4. Himalaya Publishing House, 220p.

5. Shoji Lal Bairwa, Chandra Sen, L.K. Meena and Meera Kumari. 2018. Agribusiness Management Theory and Practices, Write and Print Publications.

6. Virender Kamal vanshi. Agribusiness Management. Random.

ELECTIVE COURSE 2

MANAGEMENT OF NATURAL RESOURCES 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

UNIT I: 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 land slides, soil erosion and desertification.

UNIT II: Landscape impact analysis, wetland ecology and management. Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems. Water ecology and management. Energy resources: Growing energy needs, renewable and non- renewable energy sources, use of alternate energy sources.

UNIT III: 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.

UNIT IV: 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.

LIST OF EXPERIMENTS/PRACTICES

- Identifying natural resources and their utility.
- Practicing survey - Principles and educating to use pacing technique for measurement.
- Area calculations through chain survey - GPS demo for tracking and area measurement.
- Estimation of soil loss and calculation of erosion index.
- Leveling concepts and practical utility in agriculture.
- Preparation of contour maps.
- Concept of vegetative water ways and design of grassed water ways.
- Wind erosion and estimation process.
- Different irrigation pumps and their constructional differences.
- Farm pond construction and its design aspects.
- Visit to nearby farm pond. Visit to an erosion site.
- Exposure to strip cropping/contour bunding.

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: Focuson Land and Water. Ed. Harikesh N. Mishra. PHI, Learning, 496p.

4. Natural Resources: Their Conservation and Management by Arvindrai Upadhyay. Aspiration Academy, 320p.

5. Natural Resource Management for Growth Development and Sustainability by Vasudeva Srishti Pal. Today & Tomorrows Printers and Publishers, 336p.

ELECTIVE COURSE - 3

AGROCHEMICALS **4(3+1)**

OBJECTIVES

To impart knowledge on different classes of agrochemicals

THEORY

UNIT I: An introduction to agrochemicals, their type and role in agriculture, effect on environment, soil, human and animal health, merits and demerits of their uses in agriculture, management of agrochemicals for sustainable agriculture. Herbicides -Major classes, properties and important herbicides. Fate of herbicides. Fungicides- classification – Inorganic fungicides-characteristics, preparation and use of sulphur and copper. Mode of action- Bordeaux mixture and copper oxychloride.

UNIT II: Organic fungicides –Mode of action –Dithiocarbamates- characteristics, preparation and use of Zineb and maneb. Systemic fungicides- Benomyl, carboxin, oxycarboxin, Metalaxyl, Carbendazim, characteristics and use. Introduction and classification and insecticides: inorganic and organic insecticides organochorine, Ogranophosphates, Carbamates, Synthetic pyrethriods Neonicotinoids, Biorationals. Insecticide Act and rules, Insecticides banned, withdrawn and restricted use. Fate of insecticides in soil and plant. IGR Biopesticides, Reduced risk insecticides, Botanical, Plant and animal systemic insecticides their characteristics and uses. Fertilizers and their importance.

UNIT III: 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.

UNIT IV: 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.

LIST OF EXPERIMENTS/PRACTICES

- Sampling of fertilizers and pesticides.
- Pesticides application technology to study about various pesticides appliances.
- Quick tests for identification of common fertilizers.

- Identification of anion and cation in fertilizer.
- Calculation of doses of insecticides to be used.
- To study and identify various formulations of insecticide available kin market.
- Estimation of nitrogen in Urea.
- Estimation of water soluble P2 O5 and citrate soluble P2 O5 in single super phosphate.
- Estimation of potassium in Muraite of Potash/Sulphate of Potash by flame photometer.
- Determination of copper content in copper oxychloride.
- Determination of sulphur content in sulphur fungicide.

Suggested readings

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

ELECTIVE COURSE -4

AGRICULTURAL JOURNALISM **4(3+1)**

OBJECTIVES

To impart knowledge and skill in agricultural journalism

THEORY

UNIT I: 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.

UNIT II: 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

news paper and magazines, Standard part of news paper 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 and guidelines of writing a success story. Writing story difference between news and feature story, the principle of writing a news story, Inverted pyramid structure.

UNIT IV: 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, head line and title writing. Proofreading: definition, signs and symbols of proofreading, level of proof reading, duties of a proof-reader. Layout – meaning, principles of layout and design.

LIST OF EXPERIMENTS/PRACTICES

- 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 art work for the agricultural story.
- Practice in editing, copy reading.
- Practice in head line and title writing.
- Practicing proof reading. Practice in layout in newspaper.
- Testing copy with a readability formula.
- Visit a publishing office.

Suggested readings

1. Introduction to Journalism by Carole Fleming, Emma Hemming way, and Gillian Moore.
2. Basic Journalism by Rangaswami Parthasarathy.
3. News Reporting and Editing by K.M. Shrivastava.
4. Professional Journalism by M.V. Kamath.

5. The Journalist's Hand book by M.V. Kamath.

6. Farm Journalism and Media Management–Bhaskaranetal.

7. Agricultural Extension and farm Journalism–A K Singh.

8. Farm Journalism–Jana and Mitra.

ELECTIVE COURSE- 5

LANDSCAPING **4(3+1)**

OBJECTIVES

1. To educate the students on designing different styles and types of gardens

2. To enable the students to identify different ornamental plants and their utilization in landscaping design

3. To enable students to design land scapes in softwares like AUTOCAD, ARCHCADE etc.

THEORY

UNIT I: Importance and scope of landscaping. Principles of landscaping, garden styles and types terrace gardening, vertical gardening, garden components, adornments, lawn making, rockery water garden, walk-paths, bridges, other constructed features etc.

UNIT II: 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.

UNIT III: 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.

UNIT IV: Landscaping of urban and rural areas, Peri-urban landscaping, Land scaping 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.

LIST OF EXPERIMENTS/PRACTICES

- 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. Text book 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. Landscape Gardening: Sudhir Pradhan.2018.Scientific Publishers India.

ELECTIVE COURSE 6

COMMERCIAL PLANT BREEDING 4(3+1)

OBJECTIVES

1. To discuss about hybrid development and various crop improvement aspects of field crops viz., rice, wheat ,maize, pearlmillet, sorghum, pigeonpea, chickpea, greengram, blackgram, 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

UNIT I: Types of crops and modes of plant reproduction. Line development and maintenance breeding in self-and cross-pollinated crops (A/B/R and two-line system)f or development to f hybrids and seed production. Genetic to commercial hybrids. Advances in hybrid seed production of maize, rice, sorghum, pearl millet, castor, sunflower, cotton pigeonpea, Brassica etc.

UNIT II: Speed Breeding, Breeding Management systems, High-throughput phenotyping and genotyping platforms, Quality seed production of vegetable crops under open and protected environment.

UNIT III: Alternative strategies for the development to the line cultivators: haploid inducer, tissue culture techniques and biotechnological tools. IPR issues in commercial plant breeding:

UNIT IV: DUS testing and registration of verities under PPV and 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.

LIST OF EXPERIMENTS/PRACTICES

- Floral biology in self-and cross-pollinated species, selfing and crossing techniques
- Techniques of seed production in self- and cross- pollinated crops using A/B/R and two-line system
- Learning techniques in hybrid seed production using male- sterility in field crops.
- Understanding the difficulties in hybrid seed production
- Tools and techniques for optimizing hybrid seed production
- Concept of rouging in seed production plot
- Concept of line its multiplication and purification in hybrid seed production
- Role of pollinators in hybrid seed production
- Hybrid seed production techniques in sorghum, pearl millet, maize, rice, rapeseed-mustard, sunflower, castor, pigeon pea, cotton and vegetable crops
- Sampling and analytical procedures for purity testing and detection of spurious seed
- Seed drying and storage structure in quality seed management
- Screening techniques during seed processing, viz. grading and packaging
- Visit to public private seed production and processing plants

Suggested readings

1. Commercial Plant Breeding at a glance by Phundan Singh, Pratibha Bisen, Reshu Tiwari. Daya Publishing House.
2. Plant Breeding: Principles and Methods by B.D.Singh.KalyaniPublishers.
3. Principles of Plant Breeding (1st&2ndEdition)by R.W.Allard.
4. Commercial Plant Breeding Objective: Phundan Singh, Mridula Billore and Monika Singh. Astral Publishing, 160p.
5. Breeding and Crop Production: H. Padmalatha, Random.
6. Biotechnology for Agricultural Breeding: Mangal, S.K. Gene Tech Books.

ELECTIVE COURSE-7

FOOD SAFETY AND STANDARDS 4(3+1)

OBJECTIVES

1. To develop the skills to convert raw materials in to safe, attractive food products
2. To manage the production of food products

THEORY

UNIT I: 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.

UNIT II: 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.

UNIT III: Food Safety Management Tool- Basic concepts. PRPs, GHPs, GMPs, SSOPs etc. HACCP. ISO series. TQM- concept and need for quality, components of TQM, Kaizen. Risk Analysis. Accreditation and Auditing, Water Analysis, Surface Sanitation and Personal Hygine.

UNIT IV: Food laws and Standards Indian Food Regulatory Regime, FSSA. Global Scenario CAC. Other laws and standards related to food. Recent concerns-New and Emerging Pathogens. Packaging, Product labeling and Nutritional labeling. Genetically modified food/transgenic. Organic foods. Newer approaches to food safety. Recent Outbreaks. Indian and International Standards for food products.

LIST OF EXPERIMENTS/PRACTICES

- 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: Avantina Sharma.

2. Handbook of Food Safety: D.S.L. Khatekar and N. Sarkate. Step Up Academy, 576p.

4. Food safety and Quality Control: Pulkit Mathur. The Orient Blackswan. 332p.

5. Safe Food Handling: HACCP booklet for Food Handlers. Cletus Fernandes, Notion Press.

ELECTIVE COURSE 8

BIOFORMULATION AND NANOFORMULATION 4 (3+1)

OBJECTIVES

1. To enable students to acquire expertise and skill to develop bioformulation and Nano-formulation

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

UNIT I: 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;

UNIT II: 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

UNIT III: Nanotechnology: its applications in pest and disease diagnosis and management; Nano biopesticides: Concept and importance, different techniques of producing nano biopesticides

UNIT IV: 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.

LIST OF EXPERIMENTS/PRACTICES

- Introduction and 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 and liquid consortia of biofertilizer microbes

Suggested readings

1. Baker, E.F. and James, R.C. 1982. Biological Control of Plant Pathogens. American Phyto pathological 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, Bengaluru.

8. Prasad, Ram, Vivek Kumar, Manoj Kumar and Devendra Choudhary Eds, 2019. Nano biotechnology in Bioformulations, Kindle Edition

9. Koul, Opender Ed, 2019. Nano-biopesticides Today and Future Perspectives.

10. Shah, M. A. and Tokeer Ahmad. Nano Science and Technology, Wiley India.

ELECTIVE COURSE 9

BIOPESTICIDES AND BIOFERTILIZERS 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

UNIT I: 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.

UNIT II: 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.

UNIT III: Biofertilizers - Introduction, status and scope. Structure and characteristics features of bacterial biofertilizers – Azospirillum, Azotobacter, Bacillus, Pseudomonas, Rhizobium and Frankia; Cynobacterial bio fertilizers- Anabaena, Nostoc, Hapalosiphon and fungal biofertilizers -AM mycorrhiza and ectomycorhiza. Nitrogen fixation –Free living and symbiotic nitrogen fixation. Mechanism of phosphate solubilisation and phosphate mobilization, K solubilisation.

UNIT IV: 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.

LIST OF EXPERIMENTS/PRACTICES

- Isolation and purification of important biopestisides
- trichoderma Pseudomonas, Bacillus, Metarhyziumetc. 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, Azotobactor, Rhizobium, P-solubilizers and cyanobacteria
- Mass multiplication and inoculums production of biofertilizers
- Isolation of AM fungi- Wet sieving method and sucrose gradient method
- Mass production of AM inoculants

Suggested readings

1. Baker, E.F. and James, R.C. 1982. Biological Control of Plant Pathogens. American Phytopathological Society

2. Bhatnagar, R.K. and Palta, R.K. Earthworm Vermiculture and Vermicomposting. Kalyani Publishers.

3. Boland, G.J. and David, L.1998. Plant Microbe Interactions and Biological Control. Kuykendall Marel Dekker, INC.

4. Borkar, S.G. 2015. Beneficial Microbes as Biofertilizers and its Production Technology.

5. Ciancia, A. and Mukerji, K.J. 2007. General Concepts of Integrated Pest and Disease Management. Edited Published by Springer.

6. Cincholkar, S.B. and Mukherji, K.G. 2007. Biological Control of Plant Diseases. Hawarth Food and Agricultural Products.

7. Gehlot, Dushyent. Organic Farming: Standards, Accreditation, Certification and Inspection. Agrobios (India).

8. Gnanamanickam, S.S. 2002. Biological Control of Crop Disease. Kuykendall Marel Dekker, INC.

9. Nehra, Sampat. Biofertilizers for Sustainable Agriculture. Aavishkar Publishers, Jaipur, India.

10. Ramanujam, B. and Rabindra, R.J. 2006. Current Status of Biological Control of Plant Disease using Antagonistic Organisms in India. Precision Fototype Services, Bengaluru.

11. Singh, Awani Kr. Handbook of Microbial Biofertilizers. Agrotech Press, Jaipur, India.

12. Singh, A.K. Organic Farming. New India Publishing Agency, New Delhi.

13. Singh, S.P. and Hussanini, S.S. 1998. Biological Suppression of Plant Disease, Phytoparasitic Nematodes and Weeds. Precision Fototype Services, Bengaluru.

ELECTIVE COURSE-10

SYSTEM SIMULATION AND AGROADVISORY **4 (3+1)**

Objectives

1. To impart the knowledge of statistical and simulation modelling in crop yield estimation

2. To get acquainted with different weather forecasting techniques and their usability analysis

3. To study about the preparation and dissemination of agro-advisory bulletin

THEORY

UNIT I: System approach for representing soil-plant-atmospheric continuum, system boundaries. Crop models, concepts and techniques, types of crop models, data requirements, relational diagrams. Evaluation of crop responses to weather elements

UNIT II: Elementary crop growth models; calibration, validation, verification and sensitivity analysis. Potential and achievable crop production- concept and modelling, techniques for their estimation.

UNIT III: Crop production in moisture and nutrients limited conditions; components of soil water and nutrients balance. Weather forecasting, types methods, tools and techniques, forecast verification;

UNIT IV: 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.

LIST OF EXPERIMENTS/PRACTICES

- Preparation of crop weather calendars
- Preparation of agro-advisories based on weather forecast using various approaches and synoptic charts, Working with statistical, simulation models for crop growth
- Potential and achievable production; yield forecasting, insect and disease forecasting models
- Simulation with limitations of water and nutrient management options
- Sensitivity analysis of varying weather and crop management practices
- Use of statistical approaches in data analysis and preparation of historical, past and present meteorological data for medium range weather forecast
- Feedback from farmers about the agro- advisory

Suggested readings

1. Introduction to Agro meteorology by H. S. Mavi.

2. Agricultural Meteorology by G.S.L.H.V. Prasado Rao.

3. Advances in Plant Atmospheric Interactions (Eds. Rao, V.U.M., Rao, A.V.M.S., Rao, G.G.S.N., Ramana Rao, B.V., Vijaya Kumar, P. and Venkateswarlu, B), Central Research Institute for Dryland Agriculture (CRIDA), Santoshnagar, Hyderabad.

4. Text Book of Agricultural Meteorology by M.C. Varshneya and P.B. Pillai. ICAR.

5. Principles of Agricultural Meteorology by OP Bishnoi.

ELECTIVE COURSE - 11

HI-TECH HORTICULTURE **4 (3+1)**

OBJECTIVES

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

THEORY

UNIT I: Introduction and importance; Nursery management and mechanization; micro propagation of horticultural crops; Modern field preparation and planting methods

UNIT II: Protected cultivation: advantages, controlled conditions, method and techniques; Micro irrigation systems and its components; EC, pH based fertilizer scheduling

UNIT III: canopy management; high density orcharding; Components of precision farming: Remote sensing; Geographical Information System (GIS); Differential Geo-positioning System (DGPS);

UNIT IV: Variable Rate Applicator (VRA); application of precision farming in horticultural crops (fruits, vegetables and ornamental crops); mechanized harvesting of produce.

LIST OF EXPERIMENTS/PRACTICES

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

Suggested readings

1. Hi-tech Horticulture by T.A. More.

2. Greenhouse Operation and Management by Paul V. Nelson.

3. Hi Tech Horticulture (Pb) by S. Prasad, Dharam Singh, R.L. Bharadwaj. Agrobios

4. Instant Horticulture by S.N. Gupta. Jain Brothers. 488p.

5. Hydroponics for Beginners and Advanced: The Ultimate Hydroponic and Aquaponic Gardening Guide by Tom Garden, Webb Eleanor.

ELECTIVE COURSE 12

PROTECTED CULTIVATION **3 (2+1)**

OBJECTIVE

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

THEORY

UNIT I: Protected cultivation- importance and scope, status of protected cultivation in India and World, types of protected structure based on site and climate. Cladding material involved in greenhouse/ poly house.

UNIT II: Greenhouse design, environment control, artificial lights, Automation. Soil preparation and management, Substrate management. Types of benches and containers, Irrigation and fertigation management.

UNIT III: Propagation and production of quality planting material of horticultural crops. Greenhouse cultivation of important horticultural crops-rose, carnation, chrysanthemum, gerbera, orchid, anthurium, lilium, tulip, tomato, bell pepper, cucumber, strawberry, pot plants etc.

UNIT IV: Cultivation of economically important medicinal and aromatic plants. off- season production of flowers and vegetables. Insect pest and disease management.

LIST OF EXPERIMENTS/PRACTICES

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

Suggested readings

1. Greenhouse operation and management by Paul V. Nelson.
2. Protected cultivation of Horticultural crops by Madan Kr. Jha, Sujan Singh Paikra and Manju Rani Sahu.
3. Protected Cultivation of Horticulture Crops by Itigi Prabhakar. IBPSS.
4. Advances in Protected Cultivation by Brahma Singh and Balraj Singh. NIPA, 252p.
5. Protected Cultivation and Smart Agriculture by Eds. Sagar Maitra, Dinkar J. Gaikwad and Tanmoy Shankar. New Delhi Publishers, 263p.

ELECTIVE COURSE -13

CLIMATE RESILIENT AGRICULTURE 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

UNIT I: 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.

UNIT II: Climate resilient agriculture (CRA) – concept, scope and importance with special reference to India, climate resilient technologies for enhancing crop productivity and sustainability – role of weather and climatic information, agro advisories, ICTs and simulation models;

UNIT III: 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.

UNIT IV: 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.

LIST OF EXPERIMENTS/PRACTICES

- 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).
2. Implications for Climate Smart Agriculture by Wahid Hasan, Sachin G. Mundhe, Abdul Majid Ansari and Shivani Kumari. Biotech Books, 357p.
3. Climate Resilient Agriculture, Adaptation and Mitigation Strategies by Manish Bhan. New
1. India Publishing Agency, 294p.
4. Climate Change and Agriculture Over India by Prasad Rao. PHI Learning, 352p.

5. Climate Smart Agriculture for Sustaining Crop Productivity and Improving Livelihood Security by Prakash M. Satish Serial Publishing House.178p.

ELECTIVE COURSE-14

BIOTECHNOLOGY OF CROP IMPROVEMENT 3 (2+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

UNIT I: 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.

UNIT II: 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;

UNIT III: Direct DNA 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;

UNIT IV: 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/sg RNA 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 and 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.

LIST OF EXPERIMENTS/PRACTICES

- 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. Brown, T. A. 2006. Genomes (3rd edn). Garland Science Pub, New York.
2. Gene Cloning and DNA Analysis. 2010. Retrieved from http://biolab.szu.edu.cn/ otherweb/lzc/genetic%20engineering/courseware/b1.pdf
3. Green, M. R. and Sambrook, J. 2012. Molecular Cloning: a Laboratory Manual. Cold Spring Harbor, NY: Cold Spring Harbor Laboratory Press.
6. Kumar, Pranav and Mina, Usha. 2015. Biotechnology: A Problem Approach. Pathfinder Publication.
7. Old, R. W., Primrose, S. B. and Twyman, R. M. 2001. Principles of Gene Manipulation and Genomics 7th Edition: Oxford: Blackwell Scientific Publications.
8. Ram, Hari Har. 2019. Crop Breeding and Biotechnology. Kalyani Publications.
9. Rastogi, S.C. 2020. Biotechnology: Principles and Applications. Narosa.
10. Sander, J.D. and Joung, J.K. 2014. CRISPR-Cas systems for Editing, Regulating and Targeting Genomes. Nat Biotechnol. 32:347-355.
11. Singh, K.H., Kumar, Ajay and Parmar, Nehanjali. 2019. Agricultural Biotechnology at a Glance, science technology.
12. Slater. 2008. Plant Biotechnology: The Genetic Manipulation of Plants. Oxford, 400p.

ELECTIVE COURSE 15

GEOINFORMATICS AND REMOTE SENSING, PRECISION FARMING 4 (2+2)

OBJECTIVES

1. Enabling students acquire knowledge on basics of remote sensing technique for precision
2. farming applications
3. Provide a comprehensive knowledge of remote sensing, precision farming and its benefits in improving crop production and soil health management

THEORY

UNIT I: Introduction and history of remote sensing; sources, Principles of remote sensing, propagation of radiations in atmosphere; Interaction with matter; Application of remote sensing techniques land use soil surveys; crop stress and yield forecasting; Advantages and disadvantages of remote sensing;

UNIT II: Remote sensing institutes in India; Basic Concepts about geoinformatics. Data sharing; Expert System: Introduction to expert system, Characteristics and features of expert system, Applications of Expert System, Importance of Expert system, Rule based system architecture; Software Agents; Impact of Block chain and it's concepts;

UNIT III: Probability and Statistics: Bayes Theorem, correlation and Covariance, Continuous Random variables and probability distribution function, various forms of distributions, central limit theorem; Basics of Machine

UNIT IV: Learning: Random forest, SVM, ensemble methods; Basics of Deep learning: various model architectures and it's training aspects; Hyperspectral and Thermal Remote Sensing; Proximal Soil and Crop Sensors.

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),
- Geo referencing of topo sheets,
- Digital soil mapping with different variables,
- Basics of multivariate data analytics,
- Principal component analysis and regression applications, clustering methods and geostatistics are essential in agricultural studies.

Suggested readings

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

2. Machine Learning Approaches to Bioinformatics by Zheng Rong Yang.

3. Text Book of Remote Sensing and Geographical Information Systems by M. Anji Reddy.

4. Precision Agriculture Technologies for Food Security and Sustainability By A El-Kader, M Sherine, M El-Basioni and M Basma.

5. Principles and Theory of Geoinformatics by P.K. Garg. Khanna Publishers. 296p

6. Advances in Geoinformatics Remote Sensing and GIS by Bhunia, Gouri Sankar, Uday Chatterjee and Gopal Krishna Panda. BIO GREEN

7. Artificial Intelligence: Machine Learning, Deep Learning, and Automation Processes by John Adamssen. EfalonAcies.

8. Remote Sensing and Image Interpretation, 6th edn (WSE) Paperback – 1 January 2011, Willey Student Edition.

9. Remote Sensing and Geographic Information by A.M. Chandra and S.K. Ghosh. Narosa.

ELECTIVE COURSE - 16

MICRO-PROPAGATION TECHNOLOGIES 4 (2+2)

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

UNIT I: Introduction, History, Advantages and limitations.

UNIT II: Types of cultures (seed, embryo, organ,callus, cell); Stages of micro propagation; Axillary bud proliferation (Shoot tip and meristem culture,bud culture);

UNIT III: Organogenesis (calluys and direct organ formation); Somatic embryogenesis; Cellsuspension cultures; production of secondary metabolites;

UNIT IV: Somaclonal variation; Cryopreservation.

LIST OF EXPERIMENTS/PRACTICES

- Identification and use of equipment in tissue culture Laboratory;
- Nutrition media composition;
- Sterilization techniques for media, containers and small instruments;

- Sterilization techniques for explants;
- Preparation of stocks and working solution;
- Preparation of working medium;
- Culturing of explants:
- Seeds, shoot tip and single node; Callus induction;
- Induction of somatic embryos regeneration of whole plants from different explants;
- Hardening procedures.

Suggested readings

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

ELECTIVE COURSE 17

COMMERCIAL SEED PRODUCTION **4 (2+2)**

OBJECTIVES

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

THEORY

UNIT I: 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 apomixes, male sterility and self-incompatibility and its application in hybrid seed production of horticultural crops, Farmers participatory seed production.

UNIT II: 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.

UNIT III: 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 labelling, Seed Associations, Factors influencing seed marketing, Seed marketing programs, Seed industry organizations, Marketing of public versus private players, Demand and supply of seed; role of seed replacement rate (SRR), seed multiplication ratio (SMR), economics of seed production; determining seed needs, Seed pricing and price policy, seed processing and / packaging, demand forecasting and factors affecting demand for seeds, effect of price and farm income on seed demand, Role of WTO in seed marketing.

UNIT IV: 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.

LIST OF EXPERIMENTS/PRACTICES

- Planning of Seed Production, requirements for different classes of seeds in field crops – unit area and rate

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

Suggested readings

1. Agarwal, R.L. 1997. Seed Technology. 2nd edn. Oxford & IBH.
2. McDonald, M.B. Jr and Copeland, L.O. 1997. Seed Production: Principles and Practices. Chapman & Hall
3. Thompson, J.R. 1979. An Introduction to Seed Technology. Leonard Hill.
4. Singhal, N.C. 2003. Hybrid Seed Production in Field Crops. Kalyani.
5. Tunwar, N.S. and Singh S.N. 1988. Indian Minimum Seed Certification Standards.

6. Chawla, H.S. 2008. Introduction to Plant Biotechnology. 2nd edn. Oxford &IBH publishing Co. Ltd. 113-B Shahpur Jat, New Delhi-110049.

ELECTIVE COURSE 18

PRINCIPLES AND PRACTICES OF ORGANIC FARMING AND CONSERVATION AGRICULTURE 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

UNIT I: 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;

UNIT II: Certification process and crop standards of organic farming; Processing, labelling, economic considerations and viability, marketing and export potential of organic products.

UNIT III: Initiatives taken by Government (central/state), NGOs and other organizations for promotion of organic agriculture. Conservation agriculture: definition, origin, principles, advantages, challenges.

UNIT IV: Primary practices in conservation agriculture: minimum soil disturbance, crop residue retention, and crop diversification, complementary practices, conservation agriculture vis a vis Climate Smart Agriculture; Organic manures- recommended doses and application in comparison to inorganic fertilizers for major crops.

LIST OF EXPERIMENTS/PRACTICES

- Visit of organic farms to study the various components and their utilization;
- Preparation of enrich compost, vermicompost and their quality analysis;
- Method of application of bio fertilizers;
- Indigenous technology knowledge (ITK) for nutrient, insect-pest and disease management;
- Studies in green manuring in-situ and green leaf manuring,
- Studies on different type of botanicals for insect pest management;
- Weed management in organic farming;

- Cost of organic production system;
- Practices of conservation agriculture.

Suggested readings

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

FOOD SCIENCE AND NUTRITION **4 (2+2)**

OBJECTIVES

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

THEORY

UNIT I: 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;

UNIT II: 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;

UNIT III: Protein quality evaluation. Biochemical and nutritional aspects of vitamins, minerals, nutraceuticals, antioxidant, antinational factors and biochemistry of postharvest storage, losses during processing.

UNIT IV: 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.

LIST OF EXPERIMENTS/PRACTICES

- Proximate analysis of foods;
- calorific value of foods;
- Estimation of vitamins, phenols and flavonoids, carotenoids, anti-nutrients like Phytate/ Oxallate, Trypsin and Chymotrypsin inhibitor activities, limiting amino acids in food stuff.

Suggested readings

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

ELECTIVE COURSE - 20

POST HARVEST TECHNOLOGY AND VALUE ADDITION 2 (1+1)

OBJECTIVES

1. To educate about the different pre-harvest, harvest and post-harvest factors affecting the postharvest 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

UNIT I: Importance of post –harvest processing of fruits and vegetables, extent and possible causes of post-harvest losses: Pre-harvest factors affecting post-harvest quality, maturity, ripening and changes occurring during ripening;

UNIT II: Respiration and factors affecting respiration rate; Harvesting and field handling; Storage (ZECC, cold storage, CA, MA and hypobaric); Value addition concept;

UNIT III: Principles and methods of preservation; Intermediate moisture food (jam, jelly, marmalade, preserve, candy) - concepts and standards;

UNIT IV: 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.

LIST OF EXPERIMENTS/PRACTICES

- Applications of different types of packing, containers for shelf-life extension.
- Effect of temperature on shelf life and quality of produce.
- Demonstration of chilling and freezing injury in vegetables and fruits.
- Extraction and preservation of pulps and juices.
- Preparation of jam, jelly, RTS, nectar, squash, osmotically dried products, fruit bar candy and tomato products, canned products.
- Quality evaluation of products- Physico-chemical and sensory.
- Visit to processing unit/industry.

Suggested readings

1. Post-harvest technology of horticultural crops by S.K. Sharma and M.C Nautiyal.

2. Post-Harvest Technology by Suja Nabi Qureshi, Kounser Javeed and Abhay Kumar Sinha. Bioscientific Publishers.

3. Postharvest Technology of Horticultural Crops by K.P. Sudheer and V. Indira. New India Publishing Agency. 320p.

4. Postharvest Management and Value Addition by Aswini Kumar Goel, Rajender Kumar and Satwinder S. Mann. Daya Publishing House.

5. Postharvest Management and Value Addition of Fruits and Vegetables by Kureel M.K. Biotech, 181p.

SKILL ENHANCEMENT COURSE (SEC)

A student admitted into 1st year of B.Sc. (Hons.) Agriculture degree program will take 2 skill enhancement courses each of 2 credits in each semester of first year. Likewise, the student continuing his study into 2nd year of B.Sc. (Hons) Agriculture will undergo 1 skill enhancement course of 2 credits in each of the 2 semesters of 2nd year. The student can select these courses from a bouquet of skill enhancement courses as 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 facilities and expertise available.

Indicative skill Enhancement courses

Sl. No.	Course title	Total credits
1.	Biofertlizer 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)
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 (as per UGC guidelines for online courses) as a partial requirement for the B.Sc. (Hons.) Agriculture.

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

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

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

The courses will be non-gradial as separate certificates would be issued by the Institute/University offering the courses.

However, the University/ institute will keep a record of such courses registered and completed by each student and will indicate the title of the (successfully completed) courses in final transcript issued to the student.

BASIC COURSES

SDAR 111. DEEKSHAARAMBH (INDUCTION CUM FOUNDATION PROGRAM) 2 (0+2)

The activities to be taken under *Deeksharambh*, in addition to giving a broad view and application areas of the subject of study, also will aim at creating a platform for

- 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.

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

- Discussions on operational framework of academic process in university, as well as interactions with academic and research managers of the University
- Creating awareness on the subject of study, and the traditional values and indigenous cultures along with diverse potentialities both in indigenous and developed scenario
- Interaction with alumni, business leaders, perspective employers, outstanding achievers in related fields, and people with inspiring life experiences
- 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
- Field visits to related fields/ establishments
- Sessions on personality development (instilling life and social skills, social awareness, ethics and values, team work, leadership, etc.) and communication skills

SENG 111. COMMUNICATION SKILLS 2(1+1)

OBJECTIVES

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

THEORY

UNIT I: 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.

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

UNIT III: Structural and Functional Grammar: Sentence structure, modifiers, connecting words and verbals; phrases and clauses; Case: subjective case, possessive case; objective case;

UNIT IV: 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.

LIST OF EXPERIMENTS /PRACTICES

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

SNSS 111. NATIONAL SERVICE SCHEME (NSS) 1 (0+1)

Evoking 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 program, 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.

NSS 121. NATIONAL SERVICE SCHEME (NSS) 1 (0+1)

- 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.

SPED 211. PHYSICAL EDUCATION, FIRST AID, YOGA PRACTICES AND MEDITATION 2 (0+2)

OBJECTIVES

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

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

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

- Asanas (Definition and Importance) Padmasan, Gaumukhasan, Bhadrasan, Vajrajasan, Shashankasan, Pashchimotasan, Ushtrasan, Tadasan, Padhastasan, Ardhchandrasan, Bhujangasan, Utanpadasan, Sarvangasan, Parvatasan, Patangasan, Shishupalanasan – 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, Dhyanmudra, 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.

SBCM 321. PRINCIPLES OF BIOCHEMISTRY 3 (2+1)

OBJECTIVE

- To learn about the basic concepts of biochemistry

THEORY

UNIT I: Recapitulation of basic chemistry and biology. Water, pH and buffers. Acid-base balance. Cellular constituents and their structure and function, amino acid and proteins, carbohydrates, lipids and bio-membranes, nucleic acids.

UNIT II: Dissolved molecules– vitamins and minerals. Enzymes- function, properties and mechanism.

UNIT III: Metabolism of cellular constituents, basic concepts of bioenergetics. Carbohydrate metabolism-glycolysis and glycogenolysis, HMP pathway, TCA cycle and gluconeogenesis. Electron transport chain. Photosynthesis. Lipid metabolism-β-oxidation, ketone bodies, fatty acid synthesis.

UNIT IV: Amino acid metabolism - general reactions of nitrogen assimilation and excretion. Biosynthesis of DNA, RNA and protein- replication, transcription, translation and genetic code. Regulation of gene expression.

LIST OF EXPERIMENTS /PRACTICES

- Preparation of buffers and pH determination. Preparation of colloids.
- Qualitative and quantitative tests of carbohydrates, lipids and proteins.
- Tests of enzyme action- potato oxidase, urease, salivary amylase.
- Paper chromatography of amino acids or carbohydrates ascending and descending.
- Determination of starch and sugar.
- Analysis of proximate constituents in food.

Suggested readings

1. Eric E. Conn, Paul K. Stumpf, George Brueninh and Roy H. Doi. Outlines of Biochemistry- 5th Edition.
2. Satyanarayana U and Chakrapani U. Biochemistry by Dr.
3. Lehninger. Principles of Biochemistry. David L. Nelson and Michael M. Cox.

DEPARTMENT OF HORTICULTURE

SHRT 111. FUNDAMENTALS OF HORTICULTURE 3 (2+1)

OBJECTIVES

1. To provide knowledge of horticulture in a brief and prescribed manner
2. To familiarize students with principles and practices of management for Horticultural crops

THEORY

UNIT I: Scope and importance, classification of horticultural crops and nutritive value, area and production, exports and imports, fruit and vegetable zones of India and of different states, nursery techniques and their management, soil and climate, vegetable gardens, nutrition and kitchen garden and other types of gardens –

UNIT II: Principles, planning and layout, management of orchards, planting systems and planting densities. Methods of pruning and training of fruit crops, types and use of growth regulators in horticulture,

UNIT III: water management– irrigation methods, merits and demerits, weed management, fertility management in horticultural crops-manures and fertilizers, different methods of application, cropping systems, intercropping, multi-tier cropping, mulching– objectives, types merits and demerits,

UNIT IV: Classification of bearing habits of fruit trees, factors influencing the fruitfulness and unfruitfulness. Rejuvenation of old orchards, top working, frame working, principles of organic and Natural farming, market chain management.

LIST OF EXPERIMENTS /PRACTICES

- Features of orchard, planning and layout of orchard, tools and implements,
- Identification of various horticultural crops, layout of nutrition garden, preparation of nursery beds for sowing of vegetable/ flower seeds,
- Digging of pits for fruit plants, planting systems, training and pruning of orchard trees,
- preparation of fertilizer mixtures and field application,
- preparation and application of growth regulators, layout of different irrigation systems,
- Identification and management of nutritional disorder in fruits and vegetable crops, maturity standards, harvesting, grading, packaging and storage.

Suggested readings

1. Chattopadhyay T K 2013. A Textbook on Pomology Vol I-IV. Kalyani Publications.
2. Kumar Prasad 2014. Principles of Horticulture 2nd edn. Agrobios India.

SHRT 112. PLANT PROPAGATION AND NURSERY MANAGEMENT OF FRUIT AND PLANTATION CROPS 3 (1+2)

OBJECTIVES

1. To know different methods of propagation techniques
2. Horticultural significance of specialized vegetative structures
3. To study the different types of plant propagation methods and structures

THEORY

UNIT I: Status and importance of plant propagation and nursery production in fruits and plantation crops. Sexual and asexual methods of propagation, their advantages and disadvantages. Apomixes, seed dormancy, types of dormancy and methods to overcome seed dormancy.

UNIT II: Use of vegetative propagation methods viz. division, cutting, layering, budding and grafting. Propagation structures in nursery production: Mist chamber, humidifiers, greenhouses, glasshouses, cold frames, hot beds and poly-houses.

UNIT III: Use of growth regulators in nursery production. Components of a nursery, maintenance of mother trees and seed gardens, collection of scion-wood, and bud wood certification. Growing medium and containers used for nursery production.

UNIT IV: Role of tissue culture techniques viz. micropropagation, micrografting and meristem culture. Nursery registration act. Management of insect-pests and diseases in nursery. Cost of establishment of a modern nursery.

LIST OF EXPERIMENTS /PRACTICES

- Selection of site, soil sterilization and preparation of beds for nursery raising.
- Preparation of growing media and use of different nursery containers for containerized nursery production in fruits and plantation crops.
- Seed treatments for breaking dormancy and prevention of nursery diseases. Sowing of seed, raising and maintenance of rootstock/ seedlings.
- Practicing different vegetative propagation methods, viz. cutting, layering, grafting and budding.
- Preparation of plant growth regulators for seed germination and vegetative propagation.
- Digging, labelling and packing of field grown nursery plants.
- Familiarisation with propagation structures mist chamber, greenhouse, glasshouse, polyhouse and net house; and their maintenance.
- Micropropagation and hardening of plants.

- Tissue culture media preparation, explant preparation, *in vitro* culturing and shoot tip culture, primary and secondary hardening of tissue culture plants.
- Maintenance of nursery records. Identification and management of insect-pests and diseases in nursery.
- Project formulation for small and high-tech nurseries. Nursery Accreditation.

Suggested readings

1. Davies F T Geneve R L and Wilson S B 2018. Hartmann and Kester's Plant Propagation Principles and Practices 9th edn. Pearson. USA.
2. ICAR 2019. Handbook of Horticulture 2nd edition ICAR Vol 1 and 2. New Delhi.
3. Peter K V 2002. Plantation crops. National Book Trust India, New Delhi.
4. Sharma R R and Krishna Hare 2017. Textbook of Plant Propagation and Nursery Management. C B S Publishers. New Delhi.
5. Sharma R R and Srivastava Manish 2004. Plant Propagation and Nursery Management. IBDC Publishers. New Delhi

SHRT 324. HORTICULTURE BASED INTEGRATED FARMING SYSTEM 3 (2+1)

OBJECTIVE

To familiarize the students for farm management to deliver more sustainable agriculture

THEORY

UNIT I: Farming System-scope, importance, concept and factors affecting types of farming system. Farming system components and their maintenance. Evolution and diversity of farming systems; Stone age survival to swidden farming, Nomadic pastoralism and agro-pastoralism in warm and cold deserts of India.

UNIT II: Horticulture crop based livestock farming, subsistent livelihoods in rain-fed areas of India. Industrial and semi-industrial agriculture- agro-enterprises, agribusiness systems, their produce for marketing grains, vegetables, fruits, flowers, fibre crops, medicinal and aromatic plants. Value addition for income enhancement.

UNIT III: Integrated farming system- objectives, characteristics and its advantages and disadvantages. Site specific development of IFS model for different agro-climatic zones, resource use efficiency and optimization techniques in relation to horticulture crops. Resource cycling and flow of energy in different horticulture- based farming system and environment. Sustainable livelihood agriculture- problems and its impact on horticulture. Indicators of soil health and environment

for horticulture- based IFS.

UNIT IV: Vertical farming definition, their scope and objectives; multilayer farming, hydroponics, aeroponics-their definition, requirements, advantages, disadvantages and opportunities; Site specific horticulture- based IFS models; horticulture and vegetable intercropping systems; high density plantation; bankable IFS models; rooftop farming; Farm typology. Visit of IFS model in different agro-climatic zones of nearby states University/ institutes and farmers' field.

LIST OF EXPERIMENTS /PRACTICES

- Preparation of horticulture based cropping scheme and integrated farming system models for irrigated, rainfed and dryland situations.
- Preparation of enriched farmyard manure and vermicompost.
- Visit to urban waste recycling unit and model farmers' field.
- Preparation of farm lay out plans.
- Estimating horticulture crop yields.
- Energy budgeting in different horticulture crops.
- EC/pH/TDS of water; Hydroponics nutrient management,
- Designing of polyhouse, Net house and tunnel house;
- Mushroom farming and its various types; Seeding with soilless media.
- C- sequestration, budgeting, footprints.
- Organic fertigation in orchards; use of biorationales.
- Working out ecological optimum zones.
- Project making exercises for establishment of horticulture-based production models under different situation.

SHRT 321. PROCESSING AND VALUE ADDITION OF HORTICULTURE CROPS 3 (2+1)

OBJECTIVES

1. To make the students familiarize with the principles of food preservation and processing
2. To develop the skill set in students for value addition of horticultural produce by application of suitable food processing methods

THEORY

UNIT I: Importance and scope of fruit and vegetable processing industry in India. Food pipeline- losses in postharvest, processing and distribution systems. Losses in post-harvest operations. Unit operations in food processing-pasteurization, sterilization, blanching, canning, and bottling.

UNIT II: Principles and guidelines for selecting the location and establishment of processing units.

Principles and methods of preservation by heat, low temperature, sugar and salt, chemicals.

UNIT III: Methods of fruit juice extraction, preparation of RTS, cordials, nectars, squashes, syrups, candies, crystallized fruits, preserves, jam, jelly, marmalade, fermented beverages, vinegar, pickles, chutneys and sauces. Tomato and mushroom products, freezing of fruits and vegetables.

UNIT IV: Drying of fruits and vegetables. Processing of plantation crops, their products, spoilage in processed foods, quality control of processed products, Government policy on import and export of processed fruits. Food laws.

LIST OF EXPERIMENTS /PRACTICES

- Equipment used in food processing units.
- Canning of fruits and vegetables.
- Preparation and quality evaluation of squash, RTS, syrup, jam, jelly, marmalade, candies, preserves, chutneys.
- Dehydration of fruits and vegetables, tomato products, refrigeration and freezing, cut out analysis of processed foods.
- Visit to food processing units.

Suggested readings

1. Fellows P J. 2005. Food Processing Technology: Principles and Practice. CRC Press, Woodhead Publishing Ltd.
2. Girdhari Lal, Siddappa G S and Tandon G L. 1967. Preservation of Fruits and Vegetables. Indian Council of Agricultural Research, New Delhi.
3. Kureel M K. 2020. Postharvest Management and Value Addition of Fruits and Vegetables. Bio-Green Books.

SFLA 111. COMMERCIAL PRODUCTION OF FLOWER CROP 3 (1+2)

OBJECTIVES

- Imparting knowledge about climatic and soil requirements, commercial varieties/hybrids, sowing/planting times and methods, nutritional and irrigation requirements, intercultural operations, weed management, physiological disorders, postharvest management, plant protection measures of major flower crops.

THEORY

UNIT I: Scope and importance of flower cultivation. Soil, climate, varieties, propagation, special intercultural operations,

UNIT II: fertilizers requirement, irrigation, use of growth regulators, weed management,

plant protection measures, harvesting, grading,

UNIT III: packaging, and storage of rose, jasmine, carnation, chrysanthemum, gladiolus, marigold, tuberose and cut foliage crops under open/partial shade.

UNIT IV: Seed production of flowering annuals.

LIST OF EXPERIMENTS /PRACTICES

- Introduction of flower crops.
- Identification of commercial varieties, propagation techniques, bed preparation, soil decontamination,
- planting and layout, training, pruning, staking, growing media, potting and repotting.
- Containers for growing flowers for exhibition. Fertilizer calculations and application, growth regulator application.
- Weed management and plant protection measures. Special horticultural practices in cut flower and cut foliage crops.
- Determination of harvest indices, harvesting methods and postharvest handling.
- Commercial Standards, Packing methods.
- Project preparation.
- Visit to commercial flower market and progressive growers having high-tech farms.

Suggested readings

1. Arora JS. Introductory Ornamental Horticulture.
2. Aswath C, Bose TK, Dutta K, Reeta Bhatia and Saha T N Commercial Flowers Vol. 2.
3. Bose TK, Maiti RG, Dhua RS, Das P. Floriculture and Landscaping (Vol.1).
4. Purohit S S and Bhardwaj Prasad R L A 2016. Textbook of Production Technology of Vegetable and Flower Crops Agrobios (India); 400 p.
5. Randhawa, G. S. and Mukhopadhyay Amitabha 1986. Floriculture in India, Allied Publishers, - 660 p.
6. Vishnu Swarup 1967 Garden Flowers: Buy Garden Flowers, National Book Trust, India, 261 p.

SPMS 121. COMMERCIAL PRODUCTION OF SPICES AND PLANTATION CROPS 3(2+1)

OBJECTIVES

- To inculcate the skill of raising spices and plantation crops with appropriate agronomic practices for higher productivity

THEORY

UNIT I: Present status and importance of spice crops, soil and climate requirements, commercial varieties,

UNIT II: site selection, layout, sowing time and methods, nutritional and irrigation requirements, intercropping, weed control, physiological disorders, harvesting, post-harvest management and plant protection measures of the following crops:

UNIT III: Black pepper, turmeric, ginger, garlic, clove, cinnamon, fenugreek, cumin, ajowain, coriander, fennel, cardamom, Vanilla, betelvine and celery.

UNIT IV: Area, production and export potential of plantation crops, varietal wealth, cultivation systems, multitier cropping, high density planting, nutritional and irrigation requirements, weed management, training and pruning, physiological disorders, maturity indices, harvesting, postharvest management and plant protection measures of the following crops: Coffee, tea, cashew, rubber, coconut, arecanut, cocoa and oil palm.

LIST OF EXPERIMENTS /PRACTICES

- Identification of seeds and plants,
- propagation, nursery raising, field layout, planting methods,
- cultural practices, harvesting and handling,
- visit to fields and marketing centres.

Suggested readings

1. Kumar N 2018. Introduction to spices plantation crops medicinal and aromatic plants. Oxford and IBH publishing Co. Pvt. Ltd, New Delhi.
2. Peter K V 2002. Plantation crops. National Book Trust India, New Delhi.
3. Pruthi J S 1998. Major Spices of India Crop Management and Post Harvest Technology ICAR. Krishi Anusandhan Bhavan, Pusa, New Delhi.

SHRT 123. PLANT PROPAGATION AND NURSERY MANAGEMENT IN VEGETABLES, FLOWERS AND MEDICINAL CROP 3 (1+2)

OBJECTIVES

1. Study of biology and types of propagation, tissue culture and physiology of seed, seed storage and dormancy
2. Knowledge of nursery management, nursery establishment and nursery techniques for plant propagation
3. Propagation from specialized structures in major vegetable, flower crops, medicinal and aromatic plants

THEORY

UNIT I: Nursery management practices for vegetables, flowers and medicinal crops, Biology of plant propagation,

UNIT II: Sexual and Asexual plant propagation, physiology of seed, seed storage and dormancy, physiology of cutting, layering, grafting, budding.

UNIT III: Tissue culture, Maintenance of elite germplasm and mother stock. Propagation from specialized modified plant parts, crop specific plant propagation practices in commercial vegetables and flowers.

UNIT IV: Nursery techniques and crop specific propagation methods of medicinal crops.

LIST OF EXPERIMENTS /PRACTICES

- Identification of planting material, commercial varieties of vegetable, flowers and medicinal crops.
- Propagation and multiplication, seed production. Potting, repotting and maintenance of house plants.
- Practices in manuring, drip and fertigation, foliar nutrition, growth regulator application, pinching, disbudding, staking.
- Harvesting techniques.
- Crop-specific plant propagation practices.
- Visit to local nurseries and florist centers.
- Marketing requirements and strategies for sale of important crops.

Suggested readings

1. Plant Propagation: Principles and Practices by Hartmann and Kester
2. Plant Propagation and Nursery Management by Tarai Ranjan Kumar

SFSC 211. COMMERCIAL FRUIT PRODUCTION **4 (3+1)**

OBJECTIVES

- To acquaint the students with the cultivation techniques for commercially important tropical, sub-tropical and temperate fruit crops

Theory

UNIT I: Area, production and export potential, varieties, soil and climate requirements, propagation techniques, planting density and systems, training and pruning, high density planting, ultra-high density planting, mechanization, management of water, nutrient and weeds,

UNIT II: Physiological disorders, Special production problems, insect-pests, diseases and their control measures.

UNIT III: Post-harvest technology, harvest indices, harvesting methods, grading, packaging and storage of the following crops: mango, banana, citrus, guava, litchi, grapes, papaya, pineapple, ber, aonla, pomegranate, sapota, jamun,

UNIT IV: Date palm, apple, pear, peach, plum, cherry, almond, apricot, walnut, kiwifruit, hazelnut, chestnut, pecan nut, plantation crops (coconut, cashew nut, tea, coffee, cocoa, arecanut, palmyrah palm and strawberry.

LIST OF EXPERIMENTS /PRACTICES

- Description and identification of varieties.
- Training and pruning, application of manure, fertilizer and irrigation, weed control, maturity standards, harvesting, handling, grading and packaging of fruits.
- Visit to commercial orchards.

Suggested readings

1. Bal J S. Fruit Growing.
2. Chattopadhyay T K. A Textbook on Pomology Vol I-IV.
3. George Acquaah. Horticulture Principles and Practices.
4. ICAR. Handbook of Horticulture Vol I-II.
5. Singh Ranjit. Fruits. New Book Trust, New Delhi, 303 p.

SHRT 214. PRECISION FARMING AND PROTECTED CULTIVATION 3 (2+1)

OBJECTIVES

- The students will learn about the basics of cultivation of plants under protected conditions

THEORY

UNIT I: Precision farming – laser levelling, mechanized direct seed sowing; seedling and sapling transplanting, site specific input application. Protected cultivation technology: Introduction, techniques of protected cultivation, types of Green Houses,

UNIT II: Plant response to Greenhouse environment, Planning and design of greenhouses, Design criteria of greenhouse for cooling and heating purposes. Green house equipment, materials of construction for traditional and low- cost green houses. Irrigation systems used in protected cultivation,

UNIT III: Typical applications, passive solar green house, hot air greenhouse heating systems, greenhouse drying. Cost estimation and economic analysis. Choice of crops for cultivation under protected structures, problems/constraints of greenhouse cultivation and future strategies.

UNIT IV: Growing media, soil culture, type of soil required, drainage, flooding and leaching, soil pasteurization in peat moss and mixtures, rock wool and other inert media, nutrient film technique (NFT)/ hydroponics.

LIST OF EXPERIMENTS /PRACTICES

- Laser levelling procedure and field visit.
- Study and field visit for mechanized direct seed sowing and transplanting.
- Study of different types of greenhouses based on shape, construction and cladding materials.
- Studies on different environment control parameters in greenhouses.
- Estimation of drying rate of agricultural products inside greenhouse.
- Testing of soil and water to study its suitability for growing crops in protected structures.
- The study of fertigation requirements for greenhouse crops and estimation of E.C and pH in the fertigation solution.
- The study of various growing media used in raising of greenhouse crops and their preparation and pasteurization/sterilization.
- Visit to commercial protected cultivation structures.
- Economics of protected cultivation.

Suggested readings

1. Brahma S 2019. Precision Farming and Protected Cultivation. NIPA, New Delhi.
2. Michael A M 2008. Irrigation Theory and Practices. Vikas Publishing House Pvt. Ltd., New Delhi.
3. Kumar S 2002. Precision Farming and Protected Cultivation: Concepts and Applications. Narendra Publishing House, New Delhi.

SHRT 329. DRYLAND HORTICULTURE 3 (2+1)

OBJECTIVES

1. To acquaint the students with the soil and climatic features of the dry land areas
2. To impart the knowledge about the soil and water conservation technologies for dry land areas
3. To impart the knowledge about the production technologies for fruit crops of dry land areas

THEORY

UNIT I: Definition, importance and limitation of dry land horticulture, present status and future scope. Constraints encounter in dry lands. Agro-climatic features in rainfed areas, scarce water resources, high temperature, soil erosion, run-off losses etc.

UNIT II: Techniques and management of dry land horticulture. Watershed development, soil and water conservation methods-terraces, contour bunds etc. Methods of control and impounding of run-off water-farm ponds, trenches, macro catch pits etc. In-situ water harvesting methods, micro catchment, different types of tree basins etc.

UNIT III: Methods of reducing evapotranspiration, use of shelter belts, mulches, anti-transpirants, growth regulators, organic amendments etc. water use efficiency-need based, economic and conjunctive use of water, micro irrigation systems and fertigation etc. Water quality: characterization and use in horticultural crops. Selection of plants having drought resistance.

UNIT IV: Special techniques, planting and after care-use of seedling races, root stocks, in-situ grafting, deep pitting/planting, canopy management etc. Characters and special adaptation of crops: ber, aonla, annona, jamun, wood apple, bael, pomegranate, carissa, date palm, phalsa, fig, west Indian cherry and tamarind.

LIST OF EXPERIMENTS /PRACTICES

- Rainfall patterns. Contour bunding/trenching, micro catchments; rainfall erosivity and soil erodibility indices, measurement of runoff, soil loss and their control.
- Study of evapotranspiration, mulches and micro irrigation systems.

- Special techniques of planting and aftercare in dry lands.
- Morphological and anatomical features of drought tolerant fruit crops

Suggested readings

1. Chundawat B S 1990 Arid Fruit Culture. Oxford and IBH, New Delhi.
2. Jatav M K, Saroj P L and Sharma B D 2019. Dryland Horticulture. New India Publishing.

SHRT 215. SEED PRODUCTION OF VEGETABLE, TUBER AND SPICE CROPS

3 (2+1)

OBJECTIVES

1. Students will acquire skill for certification and storage of seed production of vegetable, tuber and spice crops
2. Students will be trained for on-farm operations of different seed multiplication activities of vegetable, tuber and spice crops.

THEORY

UNIT I: Introduction and history of seed industry in India. Definition of seed, classes-types of seed. Differences between grain and seed. Importance and scope of vegetable seed production in India.

UNIT II: Principles of vegetable seed production. Role of temperature, humidity and light in vegetable seed production, land requirements, climate, season, planting time, nursery management, seed rate, rouging, seed extraction.

UNIT III: storage, packaging and labelling of cole crops, root vegetables, solanaceous vegetables, cucurbits, okra, leafy vegetables, bulb crops, tuber crops like potato, spice crops like coriander, fenugreek, leguminous vegetables and exotic vegetables.

UNIT IV: Seed germination and purity analysis. seed priming and pelleting, Field and seed standards. Seed drying and extraction. Seed legislation.

LIST OF EXPERIMENTS /PRACTICES

- Study of seed structure, colour size, shape and texture.
- Field inspection of seed crops.
- Practices in rouging.
- Harvesting and seed extraction.
- Germination and purity analysis.
- Methods of seed production,
- Seed certification in cole crops, root vegetables, bulb crops, solanaceous vegetables, cucurbits, okra, leafy vegetables, leguminous vegetables and exotic vegetables.

- Seed processing machines.
- Visit to seed production units

Suggested readings

1. Arya Singh P. 2003. Vegetable seed Production Principles. Kalyani Publishers. Ludhiana.
2. Hazra P and Som M G. 2009. Vegetable seed production and Hybrid Technology. Kalyani Publishers, Ludhiana.
3. Kulkarni G N. 2002. Principles of Seed Technology. Kalyani Publishers, Ludhiana.
4. Ram HH, Upadhyay R, Dubey R K and Mandal B C. 2017. Vegetable seed production-Principles and practices. Kalyani Publishers, Ludhiana.

SVSC 221. COMMERCIAL VEGETABLE PRODUCTION 4 (3+1)

OBJECTIVES

- Student shall gain expertise on commercial cultivation of vegetable crops

THEORY

UNIT I: Importance of Olericulture. Vegetable gardens. Vegetable classification, area, production and varieties. Package of practices of tomato, brinjal, chillies, capsicum, moringa and okra.

UNIT II: Cucurbitaceous vegetables- cucumber, ridge gourd, ash gourd, snake gourd, bottle gourd, bitter gourd, pumpkin and melons.

UNIT III: Cole crops - cabbage, cauliflower and knol-khol. Bulb crops - onion and garlic. Beans and peas - French beans, cluster beans, dolichos beans, peas and cowpea. Tuber crops - potato, sweet potato, tapioca, colocasia, yams.

UNIT IV: Root crops - carrot, radish, turnip and beet root. Leafy vegetables – broccoli, lettuce, spinach, chinese cabbage and asparagus.

LIST OF EXPERIMENTS /PRACTICES

- Identification of vegetable crops and seeds;
- Planning, layout and maintenance of kitchen garden;
- Direct sowing of vegetables, Bed preparation and method of nursery sowing;
- Transplanting of vegetable seedlings;
- Method of fertilizer application and calculation of different fertilizer doses;
- Intercultural operations in vegetable crops,
- Harvesting, grading and packaging of vegetable crops,

- Economics of vegetable crops,
- Visit to commercial vegetable farms.

Suggested readings

1. Bose and Som 2003. Vegetable Crops. Vol I II and III. Naya Prokash.
2. Dhaliwal M S 2014. Handbook of Vegetable Crops. Kalyani Publishers.
3. Fageria M S, Choudhary B R and Dhaka Vegetable Crop Production Technology Vol II. Kalyani Publishers.
4. Hazara and Som 2015. Technology for Vegetable Production and Improvements. Naya Prokash.
5. ICAR 2019. Handbook of Horticulture Vol 1 and Vol 2, ICAR.

SHRT 226. URBAN AND PERI URBAN HORTICULTURE 2 (1+1)

OBJECTIVES

1. To acquaint the students about the unban and peri-urban horticulture and its types.
2. To impart the knowledge about the cultivation practices of horticultural crops in urban and peri-urban areas.

THEORY

UNIT I: Introduction to urban and peri-urban horticulture: Definition, importance, characteristics and scope. Types of urban and peri-urban gardens and their characteristics:

UNIT II: Terrace gardening, vegetable gardening, container gardening, rooftop gardens, community gardens, vertical gardens, hydroponics and aeroponics. Selection of site, planting material, media (soil and soilless) preparation and nutrient management for cultivation of vegetables, herbs, fruits, flowers and ornamental plants.

UNIT III: Protected cultivation in urban and peri-urban areas. Making and maintenance of lawns. Interior and exterior landscaping in urban and peri-urban households.

UNIT IV: Water and waste management, waste water recycling and its use in landscaping. Insect-pest and disease management in urban horticulture.

SHRT 317. GROWTH AND DEVELOPMENT OF HORTICULTURE CROP 3 (2+1)

OBJECTIVES

- To understand the physiology of canopy management, flowering, fruit setting and seed development in horticultural crops
- To impart basic knowledge on the natural phytohormones and their specific functions in controlling the growth and developments

- To impart basic knowledge on the natural phytohormones and their specific functions in controlling the growth and developments.
- To understand the usage of synthetic growth regulators and their applications for overall manipulation of growth and development in horticultural crops

THEORY

UNIT I: Growth and development-definitions, components, photosynthetic productivity, Canopy photosynthesis and productivity, leaf area index (LAI) - optimum LAI in horticultural crops, canopy development; different stages of growth, growth curves, Crop development and dynamics (Case studies of annual/perennial horticultural crops), growth analysis in horticultural crops.

UNIT II: Plant bio-regulators- auxin, gibberellin, cytokinin, ethylene inhibitors and retardants, basic functions, biosynthesis, role in crop growth and development, propagation, flowering, fruit setting, fruit thinning, fruit development, fruit drop, and fruit ripening.

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

UNIT IV: Physiology of seed development and maturation, seed dormancy and bud dormancy, causes and breaking methods in horticultural crops. Physiology of fruit growth and development, fruit setting, factors affecting fruit set and development, physiology of ripening of fruits-climatic and non-climacteric fruits. Physiology of fruits under post- harvest storage.

LIST OF EXPERIMENTS /PRACTICES

- Estimation of photosynthetic potential of horticultural crops, leaf area index, growth analysis parameters including harvest index,
- Bioassay of plant hormones,
- Identification of synthetic plant hormones and growth retardants,
- Preparations of hormonal solution and induction of rooting in cuttings, ripening of fruits and control of flower and fruit drop.
- Important physiological disorders and their remedial measures in fruits and vegetables, seed dormancy,
- Seed germination and breaking seed dormancy with chemicals and growth regulators.

Suggested readings

1. Jain V K 2006. Fundamentals of plant physiology (Ninth edition). S, Chand and Co., New Delhi, India.
2. Mohr H and Schopfer P 1995. Plant Physiology. Springer-Verlag, Berlin, Germany.
3. Richard PMarini: Physiology of Pruning Fruit Trees. http://pubs.ext.vt.edu/422/422-025/422-025. htmlTOC.
4. Salisbury F B and C W Ross 1992. Plant physiology (Fourth edition). Wadworth publishing Co., California, USA.
5. Taiz L and Zeiger E 2003. Plant physiology (Third edition). Sinaure Associates, Inc., Publishers, Massachusetts, USA.

LIST OF EXPERIMENTS /PRACTICES

- Site selection and layout of various urban and peri-urban gardens.
- Preparation of growing media and potting mixtures.
- Types of containers, nursery raising and planting for rooftop gardens.
- Irrigation and nutritional management in urban and peri-urban horticulture.
- Visit to fruit nutrition garden, vegetable kitchen garden and public gardens.

Suggested readings

1. Alka Singh, Patel NL and Ahlawat TR 2016. Handbook of Urban and Periurban Horticulture; Publisher: Ambica; 1st edn.
2. Sumangla HP, Malhotra S K and Chowdappa P 2013. Urban and peri-urban horticulture- A perspective.

DEPARTMENT OF AGRONOMY

SAGR 111. FARMING BASED LIVELIHOOD SYSTEMS 3 (2+1)

OBJECTIVES

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

THEORY

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

UNIT II: Prevalent Farming systems in India contributing to livelihood. Types of traditional and modern farming systems. Components of farming system/ farming based livelihood systems- Crops and cropping systems, Livestock, (Dairy, Piggery, Goa try, Poultry, Duckry etc.), Horticultural crops,

UNIT III: 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,

UNIT IV: Case studies on different livelihood enterprises associated with the farming. Risk and success factors in farming-based livelihood systems, Schemes and programs by Central and State Government, Public and Private organizations involved in promotion of farming based livelihood opportunities. Role of farming-based livelihood enterprises in 21st Century in view of circular economy, green economy, climate change, digitalization and changing life style.

LIST OF EXPERIMENTS /PRACTICES

- Survey of farming systems and agriculture-based livelihood enterprises,
- Study of components of important farming based livelihood models/ systems in different agro-climatic zones,
- Study of production and profitability of crop based, livestock based, processing based and integrated farming based livelihood models,
- Field visit of innovative farming system models.
- Visit of Agri-based enterprises and their functional aspects for integration of production, processing and distribution sectors.
- Study of agri-enterprises involved in industry and service sectors (Value Chain Models), Learning about concept of project formulation on farming- based livelihood systems along with cost and profit analysis,
- Case study of Start-Ups in agri-sectors.

Suggested readings

1. Agarwal, A. and Narain, S. 1989. Towards Green Villages: A strategy for Environmentally, Sound and Participatory Rural Development, Center for Science and Environment, New Delhi.

2. Ashley, C. and Carney, D. 1999. Sustainable Livelihoods: Lessons from Early Experience; Department for International Development: London, UK, Volume 7. [Google Scholar]
3. Dixon, J., Gulliver, A. and Gibbon, D. 2001. Farming Systems and Poverty: Improving Farmers' Livelihoods in a Changing World. FAO and World Bank, Rome, Italy and Washington, DC, USA
4. Evenson, R.E. 2000. Agricultural Productivity and Production in Developing Countries. In FAO, The State of Food and Agriculture, FAO, Rome, Italy.
5. Reddy, S.R. 2016. Farming System and Sustainable Agriculture, Kalyani Publishers, New Delhi.
6. Walia, S. S. and Walia, U. S. 2020. Farming System and Sustainable Agriculture, Scientific Publishers, Jodhpur, Rajasthan.

SAGR 318. INTRODUCTORY AGROFORESTRY 3 (2+1)

OBJECTIVE

- To develop skill and expertise on forestry, agroforestry models, wood-based industries, and nursery raising practices of important tree species

THEORY

UNIT I: Forestry – Introduction, related definitions. Objective of silviculture. Forest classification. Indian Forest Policies. Artificial and natural regeneration – objectives, choice between natural and artificial regeneration.

UNIT II: Coppicing, pollarding, root suckers. Forest mensuration – objectives, instruments for diameter, height and age measurement. Tree stem form, form factor, form quotient. Measurement of volume of felled and standing trees.

UNIT III: Agroforestry – definition, objectives and potential. Distinction between agroforestry and social forestry. Choice of species with respect to site/economic uses and constraints on tree growing. Agroforestry systems, sub-systems and practices, shifting cultivation, taungya, home gardens, alley cropping, intercropping, wind breaks, shelterbelts and energy plantations. Planning for agroforestry – constraints, diagnosis and design methodology, selection of tree - crop species for agroforestry.

UNIT IV: Agroforestry projects – national and overseas. National Agroforestry Policy 2014. MPTs (*Azadirachta indica, Acacia* species, Bamboos, *Dalbergia sissoo, Eucalyptus* species, *Grewia optiva, Gmelina arborea, Leucaena leucocephala, Melia* species, *Populus deltoides, Tectona grandis*, etc.) – nursery and planting management practices. Major wood-based industries in India –

Timber, panel, plywood, paper and pulp, match, etc. – Raw material requirements and their procurement. Economics and marketing of products raised in agroforestry systems.

LIST OF EXPERIMENTS /PRACTICES

- Identification of seeds and seedlings of tree species.
- Diameter measurements of forked, buttressed, fluted and leaning trees.
- Height measurement of standing trees by shadow method, single pole method and hypsometer.
- Volume measurement of logs using various formulae.
- Nursery practices for *Azadirachta indica*, *Acacia* species, Bamboos, *Dalbergia sissoo*, *Eucalyptus* species, *Grewia optiva*, *Gmelina arborea*, *Leucaena leucocephala*, *Melia* species, *Populus deltoides*.

Suggested readings:

1. Chundawat DS and SK Gautham. 2017. Textbook of Agroforestry. Oxford and IBH Publishing, (ISBN: 9788120408326).
2. Nair PKR, Kumar BM and VD Nair. 2021 An introduction to agroforestry – four decades of scientific developments. DOI: https://doi.org/10.1007/978-3-030-75358-0. Springer Cham
3. Parthiban KT, Umarani R, Kanna SU, Sekar I, Rajendran P and Durairasu P. 2014. Industrial agroforestry - Perspectives and Prospective. Scientific Publishers, Jodhpur.
4. Tejwani KG. 2001. Agroforestry in India. Concept Publishing Company.

SAGR 214. PRINCIPLES AND PRACTICES OF NATURAL FARMING 2 (1+1)

OBJECTIVES

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

THEORY

UNIT I: Indian Heritage of Ancient Agriculture, History of Natural Farming, Importance of natural farming; Definition; Objective of natural farming, Essential characteristics and Principles of natural farming; Scope and importance of natural farming.

UNIT II: Main Pillars of natural farming; Methods/ types/ schools of natural farming. Introduction to concept of ecological, water, carbon and nitrogen foot prints, Concept and evaluation of ecosystem

services, Rearing practices for animals under natural farming**,** Nutrient management in natural farming and their sources,

UNIT III: 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),

UNIT IV: 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.

LIST OF EXPERIMENTS /PRACTICES

- 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;
- Evaluation of ecosystem services in natural farming (Crop, Field and System).

Suggested Readings

1. Ayachit SM. 2002. Kashyapi Krishi Sukti (A Treatise on Agriculture by Kashyapa). Brig Sayeed Road, Secunderabad, Telangana: Asian Agri-History Foundation 4: 205.
2. Boeringa R. (Eed.). 1980. Alternative Methods of Agriculture. Elsevier, Amsterdam, 199 pp.
3. Dabholkar Shripad A. 2021. Plenty For All: Natural Farming A To Z Prayog Pariwar Methodology and Prayog Pariwar Prayog Pariwar.
4. 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.

5. Ecological Farming -The seven principles of a food system that has people at its heart. May 2015, Greenpeace.

6. Faires Nicole. 2016. The Ultimate Guide to Natural Farming and Sustainable Living: Permaculture for Beginners (Ultimate Guides).

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

8. Analysis for Research and Development Gordon R. Conway.1985

9. Fukuoka M. 1978. The One-Straw Revolution: An Introduction to Natural Farming. Rodale Press, Emmaus, PA. 181 pp

10. Fukuoka M. 1985. The Natural Way of Farming: The Theory and Practice of Green Philosophy. Japan Publications, Tokyo, 280 pp.

11. Hill S B and Ott P (Eds.). 1982 Basic Techniques in Ecological Farming. Berkhauser Verlag, Basel, Germany, 366 pp.

12. HLPE. 2019. Agroeeological and other innovative approaches for sustainable agriculture and food systems that enhance food security and nutrition. A report by the High Level Panel of Experts on Food Security and nutrition of the Committee on World Food Security, Rome. https://fao.org/3/ea5602en/ea5602en.pdf.

13. INFRC. 1988. Guidelines for Nature Farming Techniques. Atami, Japan. 38 pp.

14. Khurana A and Kumar V. 2020. State of Organic and Natural Farming: Challenges and Possibilities, Centre for Science and Environment, New Delhi.

15. Malhotra R and Babaji S D. 2020. Sanskrit Non Translatable- The importance of Sanskritizing English. Amaryllis, New Delhi India.

16. Nalini S. 1996. *Vrikshayurveda* (The Science of Plant Life) by Surapala. AAHF Classic Bulletin

    1. Asian Agri-History Foundation, Brig Sayeed Road, Secunderabad, AP (now Telengana), India. 94pp.

17. Nalini S. 1999. *Krishi-Parashara* (Agriculture by Parashara) by Parashara. Brig Sayeed Road, Secunderabad, Telangana: AAHF Classic Bulletin, Asian Agri-History Foundation. 104pp.

18. 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

19. Prathapan Paramu. 2021. Natural Farming Techniques: Farming without tilling.
20. Reyes Tirado. 2015. Ecological Farming- The seven principles of a food system that has people at its heart. Greenpeace Research laboratories. University of Exeter, Ottho Heldringstraat.
21. Shamasastry R. 1915. Kautilya's Arthashastra.
22. UK Behera. 2013. A text Book of Farming System. Agrotech Publishing House, Udaipur.

SAMT 312. INTRODUCTORY AGROMETEOROLOGY AND CLIMATE CHANGE 2 (1+1)

OBJECTIVES

Training graduate students with respect to management the climate aberration for sustainable crop production

THEORY

UNIT I: Agrometeorology – definition, scope. Earth atmosphere - its composition, extent and structure. Atmospheric weather variables. Elements and factors of weather and climate. Atmospheric pressure. Wind, types, daily and seasonal variation. Cyclone, anticyclone.

UNIT II: Land and sea breeze. Solar radiation - solar constant, depletion, short and long wave, thermal radiation, net radiation, albedo.

UNIT III: Atmospheric temperature, inversion, lapse rate, daily and seasonal variations, vertical profile. Energy balance of earth. Atmospheric humidity, saturation, vapor pressure, condensation. Dew, fog, mist, frost. Precipitation, process, types.

UNIT IV: Cloud formation and classification. Artificial rainmaking. Monsoon - mechanism and importance in Indian agriculture. Weather hazards. Agriculture and weather relations. Modifications of microclimate. Climatic normal for crop and livestock production. Weather forecasting – types and applications. Climate change and impacts on agriculture.

LIST OF EXPERIMENTS /PRACTICES

- Visit to agrometeorological observatory.
- Site selection of observatory and exposure of instruments and weather data recording.
- Measurement of total, short and long wave radiations and their 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, tabulation, trend and variation analysis.
- Measurement of soil temperature and computation of soil heat flux.
- Determination of vapor pressure and relative humidity.
- Determination of dew point temperature.
- Measurement of atmospheric pressure and analysis of atmospheric conditions.
- Measurement of wind speed and wind direction, preparation of wind rose.
- Measurement, tabulation and critical analysis of rainfall.
- Computation of drought indices.
- Measurement of open pan evaporation and evapotranspiration.
- Computation of PET and AET.

Suggested readings

1. Avi H S 1985. Introduction to Agrometeorology. Oxford and IBH Publishing Co., New Delhi.
2. Lenka D 2006. Climate, Weather and Crops in India. Kalyani Publishers, New Delhi.
3. Mavi H S and Tupper G J 2005. Agrometeorology – Principles and applications of climate studies in agriculture. International Book Publishing Co., Lucknow.
4. Mavi H S 1994. Introduction to Agrometeorology. Oxford and IBH Publishing Co. Pvt.
5. Pattersen S 1958. Introduction to Meteorology. Mc. Graw Hill Book Co. Inc., New York
6. Prasad Rao G S L H V 2008. Agricultural Meteorology. Prentice Hall of India Pvt. Ltd., New Delhi.

SAMT 121. ENVIRONMENTAL STUDIES AND DISASTER MANAGEMENT 3 (2+1)

OBJECTIVES

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

THEORY

UNIT I: 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.

UNIT II: 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.

UNIT III: Environmental Pollution: Definition, cause, effects and control measures of:

(a) Air pollution.

(b) Water pollution. (c) Soil pollution. (d) Marine pollution. (e) Noise pollution. (f) Thermal pollution.

(g) 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.

UNIT IV: 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.

LIST OF EXPERIMENTS /PRACTICES

- 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, 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

- De, A.K. 2010. Environmental chemistry. Published by New Age International Publishers, New Delhi. ISBN:13–978 81 224 2617 5. 384 pp
- 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.
- Erach Bharucha, Text book for Environmental studies. University Grants Commission, New Delhi.
- Parthiban, K.T., Vennila, S., Prasanthrajan, M. and Umesh Kanna, S. 2023 Forest, Environment, Biodiversity and Sustainable development. Narendra Publishing House, New Delhi, India.
- Prasanthrajan, M. and Mahendran, P.P. 2008. A text book on Ecology and Environmental Science.1st edn. ISBN 81-8321-104-6. Agrotech Publishing Academy, Udaipur - 313 002.

SHEG 111. SPRINKLER AND MICRO IRRIGATION SYSTEMS 2 (1+1)

OBJECTIVES

To acquaint the students with the basic knowledge of modern irrigation systems

THEORY

UNIT I: Sprinkler irrigation: adaptability, types, problems and prospects. Sprinkler/micro sprinkler irrigation system design: steps, layout, selection, design of lateral, sub-main and main pipeline, selection of pump and power unit.

UNIT II: Performance evaluation of sprinkler irrigation system: uniformity coefficient and pattern efficiency. Micro irrigation system: types, merits and demerits, components.

UNIT III: Design of drip irrigation system: general considerations, wetting patterns, irrigation requirement, emitter selection, hydraulics and design steps. Steps for proper operation of a drip irrigation system.

UNIT IV: Maintenance of micro irrigation system: clogging, filter cleaning, flushing and chemical treatment. Fertigation: advantages, limitations, methods, fertilizers solubility and their compatibility, precautions, frequency, duration and injection rate. Economics: Cost estimation of sprinkler and micro irrigation system.

LIST OF EXPERIMENTS /PRACTICES

- Study of different components, design and installation of sprinkler irrigation system.
- Determination of precipitation pattern, discharge and uniformity coefficient.
- Study of different components, design and installation of drip irrigation system.
- Determination of pressure discharge relationship and emission uniformity for emitter.
- Study of different types of filters and determination of filtration efficiency.
- Determination of rate of injection and calibration for chemigation / fertigation.
- Design of irrigation and fertigation schedule for crops.
- Field visit to micro irrigation system and evaluation of drip system.
- Cost economics of sprinkler and drip irrigation system.

Suggested readings

1. Biswas, R.K. 2015. Drip and Sprinkler Irrigation. New India Publishing Agency.
2. Goyal, M.R. 2016. Micro Irrigation Management Technological Advances and Their Applications - Innovations and Challenges in Micro Irrigation. CRC Press.
3. James, L.G. 1993. Principles of Farm Irrigation System Design. Krieger publishing Company, Malabar, Florida.

DEPARTMENT OF AGRONOMY

SAGR 122. INTRODUCTION TO MAJOR FIELD CROPS 3 (2+1)

OBJECTIVES

1. To provide in-depth understanding about crop response to variable agronomic factors
2. To inculcate the skill of raising field crops with appropriate agronomic practices for higher productivity

THEORY

UNIT I: Classification and distribution of field crops, definition, concept and principles of multiple cropping, mixed cropping,

UNIT II: Intercropping, relay and alley cropping, crop rotation. Economic importance, soil and climatic requirement, varieties, cultural practices for raising major cereals (rice, wheat, maize),

UNIT III: pulses (gram, soybean, arhar moong), oilseeds (rapeseed and mustard, sunflower, groundnut), cash crops (cotton, sugarcane)

UNIT IV: fodder crops (sorghum, *bajra*, berseem, oats). Principles and practices of green manuring.

LIST OF EXPERIMENTS /PRACTICES

- Identification of crop plants, seeds, weeds.
- Preparation of cropping scheme.
- Method of sowing, fertilizer and herbicide application in field crops.
- Calculation of fertilizer and herbicide dose.

Suggested readings

2. Anonymous, 2023, Package of practices for *kharif* crops.

3. Anonymous, 2023, Package of practices for *rabi* crops.

4. Reddy T Y and Reddy G H S, 2020, Principles of Agronomy, Kalyani Publishers, Ludhiana.

5. Singh Chidda, 2020, Modern techniques of raising field crops. Oxford and IBH Publication.

DEPARTMENT OF ECONOMICS

SAEC 312. ECONOMICS AND MARKETING 3 (2+1)

OBJECTIVES

1. To introduce the student about the concepts, subject matter and importance of study of economics.

2. To make the student understand about the terms - goods, service, value, price, wealth, welfare.

3. To impart knowledge to the student about the concept of wants, utility and consumer surplus.

4. To expose the students to the laws of marginal utility and their importance.

5. To provide an overview to the students about the concept of demand, kinds of demand and law of demand.

6. To aware the student about the concept of supply, law of supply and price determination of commodity under equilibrium condition.

7. To aware the student about factors of production and their characteristics

8. To provide an overview to the student about the Gross Value Added.

9. To expose the students to the concept of marketing, market, price spread, marketing efficiency, integration, marketing functions, classification of markets and marketing channels.

10. To aware the students about the market intelligence, constraints in marketing of agricultural produce.

11. To impart knowledge to the student about Basic guidelines for preparation of project reports, Bank norms, Insurance, SWOT analysis, crisis management.

THEORY

UNIT I: Economics – Terms and definitions; Consumption, demand, price and supply; Factors of production; Gross Value Added.

UNIT II: Role of Biotechnology/Agriculture Sector in National GVA.

Marketing – definition; Marketing process; Need for marketing; Role of marketing; Marketing functions;

UNIT III: Classification of markets; Marketing of various channels; Price spread; Marketing efficiency; Constraints in marketing of agricultural produce; Market intelligence.

UNIT IV: Basic guidelines for preparation of project reports; Bank norms; Insurance; SWOT analysis; Crisis management.

LIST OF EXPERIMENTS /PRACTICES

- Techno-economic parameters for preparation of projects;
- Preparation of bankable projects for various biotechnology/ agricultural products and value-added products; Identification of marketing channel;
- Calculation of price spread;
- Identification of market structure;
- Visit to different markets, market institutions;
- Study of SWC, CWC and STC;
- Analysis of information of daily prices; Marketed and marketable surplus of different commodities.

Suggested Readings

1. Acharaya S S and Aggarwal N L, Agricultural Marketing in India.
2. Gupta R D, Elementary Economic Theory.
3. Dewett K K, Modern Economic Theory.
4. Dewett K K and Verma J D Elementary Economic Theory.

SAEX 211. ENTREPRENEURSHIP DEVELOPMENT AND BUSINESS MANAGEMENT 3 (2+1)

OBJECTIVES

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

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

process of entrepreneurship development.

UNIT II: 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.

UNIT III: 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.

UNIT IV: 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.

LIST OF EXPERIMENTS /PRACTICES

- Visit to small scale industries/agro-industries,

- Interaction with successful entrepreneurs/ agric- entrepreneurs.
- Visit to financial institutions and support agencies.

Suggested readings

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

SHEC 312. AGRICULTURE MARKETING AND TRADE 3 (2+1)

OBJECTIVES

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

THEORY

UNIT I: 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:

UNIT II: 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:

UNIT III: 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 and DMI – their objectives and functions; cooperative marketing in India; Risk in marketing: Types of risk in marketing; speculation and hedging; an overview of futures trading; Agricultural prices and policy: Meaning and functions of price; administered prices; need for innovations in agricultural price policy.

UNIT IV: 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.

LIST OF EXPERIMENTS /PRACTICES

- 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;
- 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.
- Study their organization and functioning.

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. Kotler and Armstrong, 2005, Principles of Marketing, Pearson Prentice-Hall.
5. Lekhi, R. K. and Jogindr Singh, 2006, Agricultural Economics. Kalyani Publishers, Delhi.
6. Memoria, C.B., Joshi, R.L. and Mulla, N.I., 2003, Principles and Practice of Marketing in India, Kitab Mahal, New Delhi.
7. Pandey Mukesh and Tewari, Deepali, 2004, Rural and Agricultural Marketing, International Book Distributing Co. Ltd, New Delhi.
8. Sharma, R., 2005, Export Management, Laxmi Narain Agarwal, Agra.

DEPARTMENT OF SOIL SCIENCE

SSAC 211. FUNDAMENTALS OF SOIL SCIENCE 3 (2+1)

OBJECTIVES

• To make the students aware about the importance of soil in relation to soil formation, texture, structure, water, temperature, aeration, nutrient availability, and soil microbiology, soil survey

THEORY

UNIT I: Composition of earth's crust, soil as a natural body – major components. Eluviation, Illuviation formation of various soils. Physical parameters; texture – definition, methods of textural analysis, stock's law, assumption, limitations, textural classes, use of textural triangle; absolute specific gravity/ particle density, definition, apparent specific gravity/bulk density – factors influencing, field bulk density. Relation between BD (bulk density), AD – practical problems. Pore space – definition, factors affecting capillary and non-capillary porosity, soil colour – definition, its significance, colour variable, value hue and chroma.

UNIT II: Munsell colour chart, factors influencing, parent material, soil moisture, organic matter, soil structure, definition, classification, clay prism like structure, factors influencing genesis of soil structure, soil consistency, plasticity, Atterberg's constants. Soil air, air capacity, composition, factors influencing, amount of air space, soil air renewal, soil temperature, sources and distribution of heat, factors influencing, measurement, chemical properties, soil colloids, organic, humus, inorganic, secondary silicate, clay, hydrous oxides.

UNIT III: Ion exchange, cation-anion importance, soil water, forms, hygroscopic, capillary and gravitational, soil moisture constants, hygroscopic coefficient, wilting point, field capacity,

moisture equivalent, maximum water holding capacity, energy concepts, PF scale, measurement, gravimetric – electric and tensiometer methods – pressure plate and pressure membrane apparatus.

UNIT IV: Neutron probe–soil water movement–classification– aerial photography– satellite of soil features – their interpretation; soil orders; land capability classification; soil of different eco-systems and their properties, Rock and Minerals classification, Pedogenic process. Objectives of soil science research institute in India (NBSS and LUP, ISSS, LTFE and NSSTL). Management of Soil Crusting, Soil Compaction and Soil Compression. Soil Biology benefits and harmful effects. Methods and objective of soil survey, Remote sensing application in soil and plant Studies, Soil degradation.

LIST OF EXPERIMENTS /PRACTICES

- Collection and preparation of soil samples, estimation of moisture, EC, pH and bulk density.
- Textural analysis of soil by Robinson's pipette method.
- Description of soil profile in the field.
- Quantification of minerals and their abundance.
- Determination of Soil colour using Munsell Chart.
- Estimation of water holding capacity and hydraulic conductivity of soils.
- Estimation of Infiltration rate using double ring infiltrometer method.
- Estimation of soil moisture using gypsum block and neutron probe method.
- Soil compaction measurement with Pentrometer.
- Determination of pore space of soil.
- Determination of field capacity and permanent wilting point of soil.
- Determination of soil water potential characteristic curves by tensiometer and pressure plate apparatus.
- Aggregate size distribution analysis of soil.
- Air capacity of soil by fieldmeth
- Nursery raising/procurement and transplanting, management and maintenance of the crop, postharvest handling, quality control and marketing.

Suggested readings

- Das D K. 2011. Introductory Soil Science Third Revised Edition Kalyani Publishers. Ludhiana.
- Fundamentals of Soil Science by Indian Society of Soil Science Second Revised Edition 2009. Indian Society of Soil Science. New Delhi.

SSAC 122. SOIL FERTILITY AND NUTRIENT MANAGEMENT 3 (2+1)

OBJECTIVES

- To acquaint students with the basic knowledge of soil fertility and nutrient management, as to understand the key factors affecting plant growth and development.

THEORY

UNIT I: Plant nutrients - classification and sources; Essential and beneficial elements, criteria of essentiality, forms of nutrients in soil, mechanisms of nutrient transport to plants, factors affecting availability of major, secondary and micro-nutrients to plants.

UNIT II: Measures to overcome deficiency and toxicities. Soil fertility- different approaches for soil fertility evaluation; Soil testing for available nutrients; Critical levels of different nutrients in soil.

UNIT III: Plant analysis- total and rapid tissue tests- critical levels of nutrients in plants; DRIS method; Deficiency symptoms-indicator plants. Biological method of soil fertility evaluation. Soil test-based fertilizer recommendations to crops. Site-specific and plant need-based nutrient management.

UNIT IV: Factors influencing nutrient use efficiency (NUE) in respect of N, P, K, S, Fe and Zn fertilizers. Source, method and scheduling of nutrients for different soils and crops grown under rainfed and irrigated conditions. Integrated plant nutrient supply system and its management. Soil quality in relation to sustainable agriculture-acid, salt affected and calcareous soils, characteristics, nutrient availabilities, Reclamation- mechanical, chemical and biological methods.

LIST OF EXPERIMENTS /PRACTICES

- Analytical Instruments- principles, calibration and applications;
- Estimation of available nitrogen, available phosphorus, available potassium and available sulphur in soil;
- Estimation of exchangeable calcium and magnesium in soil,
- Estimation of available micronutrients in soils;
- Preparation of plant samples for analysis;
- Estimation of nitrogen, phosphorus and potassium in plants.

Suggested readings

1. Aggarwal JP Yawalkar KS and Bokde S 2011. Manures and Fertilizers 11th edn. Agri Horticultural Publishing House. Nagpur.
2. Basak Ranjan Kumar 2016. Fertilizers A Text Book, Fourth edition. Kalyani Publishers. Ludhiana.
3. Brady NC 1999. Nature and Properties of Soils 10th Edition.
4. Das PC 2015. Manures and Fertilizers Third edition Kalyani Publishers. Ludhiana.

SPAT 211. DISEASE MANAGEMENT OF HORTICULTURE CROPS 3 (2+1)

OBJECTIVES

1. To identify various pathogen structures and diagnose the diseases of horticultural crops in field
2. To understand the disease cycle and epidemiology of various diseases of horticultural crops
3. To give an overview of various disease management methods (cultural, physical biological, chemical)

THEORY

UNIT I: Etiology, symptoms, mode of spread, epidemiology and integrated management of the diseases under protected conditions and of fruits, plantation, medicinal, aromatic, vegetables, ornamental, and spice crops viz mango, litchi, banana, grape, citrus, guava, sapota, papaya, jack fruit, pineapple, pomegranate, ber, apple, pear, peach, plum, almond, walnut,

UNIT II: Strawberry, tomato, brinjal, chilli, bhindi, cabbage, cauliflower, radish, knol-khol, pea, beans, beet root, onion, garlic, fenugreek, ginger, potato, areca nut, coconut, oil palm, coffee, tea, cocoa, cashew, rubber, betel vine, senna, neem, hemp, belladonna, pyrethrum, camphor, costus, crotalaria, datura, dioscorea, mint, opium, Solanum khasianum.

UNIT III: Tephrosia, turmeric, pepper, cumin, cardamom, nutmeg, coriander, clove, cinnamon, jasmine, rose, crossed, tuberose, gerbera, anthurium, geranium, marigold, gladiolus. Important post-harvest diseases of fruit, plantation, medicinal, aromatic, vegetables, ornamental and spice crops and their management.

UNIT IV: Etiology, symptoms and integrated management of important plant parasitic nematodes of fruits – (tropical, sub-tropical and temperate) vegetables, tuber, ornamental, spice and plantation crops. Role of nematodes in plant disease complex.

Suggested readings

1. Gupta S K and Thind T S 2018. Disease problems in Vegetable Production. Scientific Publishers India, P.586.
2. Gupta S K Sharma R C and Sharma M 2017. Diseases of Vegetable. Ornamental and Spice crops. Scientific Publishers India.
3. Mehrotra R S and Aggarwal A 2003. Plant Pathology. 2nd edn. Tata Mc Graw Hill Publication Com Ltd, P.846.
4. Pathak V N 1989. Diseases of fruit crops. Oxford and IBH Publication Comp. New Delhi.

DEPARTMEENT OF PLANT PATHOLOGY

SPAT 323. GENERAL MICROBIOLOGY 3 (2+1)

OBJECTIVE

To provide knowledge about general concepts of microbiology.

THEORY

UNIT I: Evolution and scope of microbiology. History of microbiology. Microbial classification, nomenclature and identification. Taxonomic groups. General methods of classifying bacteria.

UNIT II: Microscopy and microscopes: Smears and staining. Morphology and fine structure of bacteria. Cultivation of bacteria, nutritional requirements. Nutritional classification of bacteria; Phototrophs, chemotrophs, autotrophs and heterotrophs; Obligate parasites; Bacteriological media, Growth of bacteria, Reproduction of bacteria; Introduction to fungi, algae and protozoa and virus, Microbiology of water and food Nutrient transport phenomenon: Passive diffusion, facilitated diffusion;

UNIT III: Group translocation, active transport. Metabolism in bacteria –ATP generation Microbial genetics; Bacterial recombination; Bacterial conjugation, transduction; Bacterial transformation; Mutations: Types of mutations, mutagenesis; Mutation rate, repair of mutations; Phenotypes of bacterial mutants; Designation of bacterial mutants;

UNIT IV: Destruction of microorganisms: Physical agents and chemical agents; Chemotherapeutic agents and chemotherapy; Characteristics of antibiotics; Mode of action of antibiotics; Pure culture: Methods of isolation of pure cultures; Maintenance and preservation of pure cultures; Culture collections.

LIST OF EXPERIMENTS /PRACTICES

- Microscopy; Micrometry;
- Cleaning and sterilization of glassware and acquainting with equipment used in microbiology;
- Preparation of nutrient agar media and techniques of inoculation;
- Staining methods (monochrome staining,
- Gram staining, negative staining, capsule-staining, flagella staining and endospore staining); Pure culture techniques (streak plate/pour plate/spread plate);
- Identification procedures (morphology and cultural characteristics)

- Growth characteristics of fungi:
- Determination of microbial numbers, direct plate count, generation time;
- Factors influencing growth: pH, temperature, growth curves for bacteria.

Suggested Readings

1. Dubey RC and Maheshwari DK. 2013. A Textbook of Microbiology S Chand Publishing, New Delhi.
2. Gerard JT, Berdell RF and Christine LC. 2014. Microbiology: An Introduction. 12th edn. Prentice-Hall, NY, USA.
3. Johanne MW, Linda MS and Woolverton CJ. 2013. Prescott's Microbiology. 9th edn. McGraw- Hill Higher Education, NY, USA.
4. Pelczar MJ, Chan ECS and Noel RK. 1998. Microbiology. 5th edn. Tata McGraw-Hill Education, New Delhi.
5. Purohit SS. 2001. Microbiology-Fundamentals and Applications. Agrobios, New Delhi.
6. Sharma PD. 1999. Microbiology. Rastogi Publications, Meerut, India.

DEPARTMENT OF AGRICULTURAL ENGEENERING

SHEG 222. FARM POWER AND MACHINERY FOR HORTICULTURE 3(2+1)

OBJECTIVES:

- To acquaint students of the tools available at his disposal for doing the work in horticulture (mechanical power source: engines/ tractors; machines and tools for harvesting the horticultural produce: tillage equipment, planting equipment, plant care equipment)

THEORY

UNIT I: Basic concepts of various forms of energy; Tractors, power tillers and their types and uses Introduction about IC Engines: Basic principles of operation of compression, ignition and spark ignition engines; two stroke and four stroke engines; Crank system, valve system, fuel supply system, cooling and lubrication systems; power transmission systems; broad understanding of performance and efficiency.

UNIT II: Tillage: objectives, method of ploughing. Primary tillage implements: construction and function of improved indigenous ploughs, mould board ploughs, disc and rotary ploughs, offset rotavators. Secondary tillage implements construction and function of cultivators, harrows, levellers, ridgers and bund formers.

UNIT III: Adjustments affecting performance in tillage equipment. Calculation of bite length of

rotavator. Post-hole digger. Introduction about planting and transplanting equipment: potato planters, small seed planter, nursery sowing machinery, vegetable transplanters, plastic mulch and drip laying machinery. Introduction about intercultural machinery.

UNIT IV: Sprayers: Types, working principle, manual and tractor operated, gun-type and boom type. Special purpose sprayers: aero- blast sprayers, electrostatic sprayers, sprayer calibration and nozzle spacing. Safety features and safe use, shrub cutters, pick positioner; grafting, pruning and training tools and equipment; sweep, rotary weeders, tractor operated pruners. Crop harvesting equipment: potato diggers, fruit-pluckers, seed extraction machine.

LIST OF EXPERIMENTS /PRACTICES

- Calculation on force, power and energy.
- IC engines – showing the components of dismantled engines.
- Familiarization with engine systems Primary and secondary tillage implements: hitching, adjustments and operations.
- Operation of post hole digger.
- Operation of planting and transplanting machinery.
- Operation of vegetable transplanter, plastic mulch and drip laying machinery.
- Operation of Inter-culture equipment including offset rotavator in orchard; calibration of plant protection equipment, calculation of dilution ratio and operation; operation of power weeder, shrub cutter.
- Operation of crop harvesting equipment and seed extraction machine. Operation of shrub cutters, fruit-pluckers, pick positioner.

Suggested readings

1. Sahay Jagdishwar. Elements of Agricultural Engineering.
2. Kepner R A, Bainer R and Barger E L. Principles of Farm Machinery.
3. MichaelA M and OjhaT P. Principles of Agricultural Engineering.
4. Culpin C. Farm Machinery.
5. Rodichev V and Rodicheva G. Tractors and Automobiles.

SAEG 223. AGRICULTURE INFORMATICS AND ARTIFICIAL INTELLIGENCE 3(2+1)

OBJECTIVES

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

THEORY

UNIT I: 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.

UNIT II: 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.

UNIT III: 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,

UNIT IV: 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.

LIST OF EXPERIMENTS /PRACTICES

- Study of computer components, accessories, practice of important DoS Commands, Introduction of different operating systems such as Windows, Unix/ Linux, creating files and folders,
- File Management. Use of MS-Word and MS Power-point for creating, editing and presenting a scientific document, 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. Concepts and Techniques of Programming in C by Dhabal Prasad Sethi and Manoranjan, Wiley India.
2. Fundamentals of Computer by V. Rajaroman.
3. Introduction to Information Technology by Pearson.

DEPARTMENT OF ENTOMOLOGY

SENT 221. PEST MANAGEMENT OF HORTICULTURE CROPS 3(2+1)

THEORY

UNIT I: Classification of insect-pests. Dynamics of EIL and ETL. Methods of pest control - host plant resistance, cultural, mechanical, physical, legislative, biological and chemical control. Recent technologies for insect-pest management.

UNIT II: Insecticides, classification, formulations, first aid and antidotes. IPM – importance and principles. Scientific name, order, family, host range, distribution, biology, ecology, nature of damage and management of important insect-pests of various fruit (tropical, sub-tropical and temperate), vegetable, ornamental, plantation, spice, medicinal, aromatic crops and under protected conditions. Pest surveillance.

UNIT III: Storage insects – Scientific name, order, family, host range, distribution, biology, ecology, nature of damage and management of important insect-pests attacking stored fruit, vegetable, plantation, ornamental, spice, medicinal and aromatic crops' produce and their processed products.

UNIT IV: Insecticides residue problems in fruit, vegetable, plantation, ornamental, spice, medicinal and aromatic crops and their maximum residue limits (MRLs). Waiting periods for insecticides on various crops.

LIST OF EXPERIMENTS /PRACTICES

- Identification of insect-pests of various fruit,
- vegetable, plantation, ornamental, spice, medicinal and aromatic crops in field and their produce during storage, and their symptoms of damage.
- Identification of biocontrol agents and natural enemies.
- Insecticide formulations.
- Pesticide application appliances.
- Calculation of insecticide quantity for preparing spray material.

Suggested readings

1. Integrated Pest management concepts and approaches by G S Dhaliwal and Ramesh Arora
2. Agricultural Pests of South Asia and their Management by A S Atwal and G S Dhaliwal
3. Essentials of Agricultural entomology by G S Dhaliwal, Ram Singh and B S Chillar
4. Applied Animal Ecology by A S Atwal and S S Bains.

DEPARTMENT OF GENETICS AND PLANT BREEDING

SGPB 222. FUNDAMENTALS OF PLANT BREEDING 3 (2+1)

THEORY

UNIT I: Historical development, concept, nature and role of plant breeding. Major achievements and future prospects. Genetics in relation to plant breeding. Modes of reproduction. Male sterility - genetic consequences and cultivar options. Domestication, acclimatization and introduction. Centres of origin/diversity.

UNIT II: 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.

UNIT III: Modes of selection. Population improvement 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.

UNIT IV: Wide hybridization and pre-breeding. Polyploidy in relation to plant breeding. Mutation breeding - methods and uses. Breeding for important biotic and abiotic stresses. Introduction to biotechnological tools - DNA markers and marker assisted selection. Participatory plant breeding. Plant Breeders' and Farmers' Rights.

LIST OF EXPERIMENTS /PRACTICES

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

Suggested Readings

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

DEPARTMENT OF AGRICULTURE EXTENSION

SHEX 313. INFORMATION AND COMMUNICATION TECHNOLOGY IN HORTICULTURE 3 (1+2)

OBJECTIVES

- To learn basics of computing and its practical use in communication

THEORY

UNIT I: and its importance. IT tools, IT-enabled services and their impact on society; Introduction to Computers, hardware and software; input and output devices; word and character representation; features of machine language, assembly language, high-level language and their advantages and disadvantages;

UNIT II: Operating Systems, definition and types, Applications of Word Processing / Spreadsheet /Presentation /Databases for document creation and Editing,

UNIT III: Data presentation, interpretation and graph creation, statistical analysis, mathematical expressions, Database concepts and types, uses of DBMS in Horticulture; Introduction to Local area network (LAN),

UNIT IV: Wide area network (WAN), Internet and World Wide Web, HTML and IP and Video conferencing, Introduction to e- Horticulture, concepts and applications, Use of ICT in Horticulture.

LIST OF EXPERIMENTS /PRACTICES

- Practice with latest operating system for creating Files, Folders, File Management.
- Use of Word Processing/ Spreadsheet/ Presentation/ Databases with latest software packages; Creating a spreadsheet,
- Use of statistical tools, writing expressions, creating graphs, analysis of scientific data.
- Creating Database, preparing queries and reports, creation and operation of E mail account;
- Demonstration of Agri-information system using Mobile Apps.
- Internet applications: Web browsing, handling of audio-visual equipment.

- Planning, preparation, presentation of posters, charts. Introduction of Geospatial
- Technology of generating valuable information for Agriculture.
- Hands on Decision Support System.
- Preparation of contingent crop planning.

Suggested readings

1. Comer Douglas E. 2018. The Internet book: everything you need to know about computer networking and how the Internet works. Chapman and Hall/CRC.
2. Crowther R, Joe L, Ash Blue, and Wanish G. 2014. HTML5 in Action. Manning.

SHEX 122. PERSONALITY DEVELOPMENT 2 (1+1)

OBJECTIVES

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

THEORY

UNIT I: 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.

UNIT II: 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.

UNIT III: 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.

UNIT IV: 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.

LIST OF EXPERIMENTS /PRACTICES

- 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 readings

1. Andrews, Sudhir, 1988, How to Succeed at Interviews. 21st (rep.) New Delhi.Tata McGraw- Hill.
2. Hindle, Tim, 2003, Reducing Stress. Essential Manager series. Dk Publishing.
3. Kumar, Pravesh, 2005, All about Self- Motivation. New Delhi. Goodwill Publishing House.
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. Smith, B., 2004, Body Language. Delhi: Rohan Book Company.
7. Shaffer, D. R., 2009, Social and Personality Development (6^{th} edn). Belmont, CA: Wadswor.

DEPARTMENT OF PLANT PHYSIOLOGY

SCPH 312. INTRODUCTORY CROP PHYSIOLOGY 2 (1+1)

OBJECTIVES

1. To study different physiological plant aspects such as water uptake and movement in plants, nutrient absorption, assimilation
2. To study factors affecting photosynthesis and its importance in plants

THEORY

UNIT I: Water Relations in Plants: Role of water in plant metabolism, osmosis inhibition, diffusion, water potential and its components, measurement of water potential in plants, absorption of water, mechanism of absorption and ascent of sap. Stomata: Structure, distribution, classification, mechanism of opening and closing of stomata.

UNIT II: Osmotic pressure, guttation, stem bleeding; transpiration methods and mechanism and factors affecting transpiration. Drought: Different types of stresses; water, heat and cold tolerance; mechanism of tolerance.

UNIT III: Plant Nutrition: Essentiality, mechanism of absorption and its role in plant metabolism. Biological Nitrogen Fixation. Photosynthesis, structure and function of chloroplast, dark and light reactions, cyclic and on-cyclic electron transfer, CO2 fixation – C3, C4 and CA metabolism, advantages of C4 pathway.

UNIT IV: Photorespiration and its implications, factors affecting photosynthesis. Mode of herbicide action, Secondary metabolites and plant defense.

LIST OF EXPERIMENTS /PRACTICES

- Measurement of water potential,
- osmosis, root pressure, structure of the stomata, distribution,
- opening and closing of the stomata, measurement.
- Transpiration and calculation of transpiration Pull demonstration. Importance of light and chlorophyll in photosynthesis, pigment identification in horticultural crops, measurement of relative water content (RWC), studying plant movements.

Suggested Readings

1. Bendre AM and Pande PC, 2009, Introductory Botany. Rastogi publication, Meerut.
2. Bhatia KN, 2015, Plant Physiology. Trueman Book Company, Jalandhar.
3. Dutta AC, 2013, A Textbook of Botany. Oxford University Press, Oxford Lecture Schedule.
4. Gardner FP, Pearce R Band Mitchell RL, 2003, Physiology of Crop Plants. Scientific Publishers, Jodhpur.
5. Jain V K, 2019, Fundamentals of Plant Physiology. S Chand Publishers, New Delhi.

AGRICULTURAL STATISTICS

SHST 321. BASIC STATISTICS AND EXPERIMENTAL DESIGNS 3 (2+1)

OBJECTIVES

1. To understand the analytical techniques for data analysis and interpretation
2. To help students to compete for various competitive examinations

THEORY

UNIT I: Definition of statistics, its use and limitations. Variable statistics, types and sources of data, classification and tabulation of data. Construction of frequency distribution tables – graphic presentation of data, simple, multiple component and percentage, bar diagram, pie diagram, histogram, frequency polygon and frequency curve, cumulative frequency curve.

UNIT II: Measures of central tendency: mean, median, mode, geometric mean, harmonic mean, percentiles and quartiles for raw and grouped data, Measures of dispersion: range, quartile deviation, mean deviation, standard deviation for raw and grouped data, coefficient of variation.

Skewness and kurtosis. Probability- definition, additive and multiplicative law for two events, Normal distribution and its properties. Introduction of sampling. basic concepts, sampling vs. Complete enumeration parameter and statistic.

UNIT III: Sampling techniques (simple random sampling: lottery method and random number table method). Tests of significance, Null hypothesis, Alternate hypothesis, Type I and II Error, one and two tail tests, level of significance and confidence interval. Large sample tests for mean (Single sample and two samples), Student's t-test for single sample, two samples and paired t-test, F-test, Chi- square test for application of attributes (contingency table) and test for goodness to fit of Mendalian ratios, Yates' correction for continuity.

UNIT IV: Correlation-scatter diagram and Karl Pearson coefficient of correlation for ungrouped data and its testing. Linear regression and its properties. Inter-relation between 'r' and the regression coefficient, Introduction to design of experiment- Basic principles of experimental design-replication, randomization and local control, Analysis of variance (ANOVA) and its assumptions, analysis of Completely Randomized Design (CRD), Randomized Block Design (RBD) and Latin Square Design (LSD), Comparisons based on means-critical difference.

LIST OF EXPERIMENTS /PRACTICES

- Construction of frequency distribution tables and frequency curves,
- Measures of central tendency: mean, median, mode, geometric mean, harmonic mean, percentiles and quartiles.
- Measures of dispersion: range, quartile deviation, mean deviation, standard deviation for raw and grouped data, coefficient of variation.
- Skewness and kurtosis.
- Probability. Large sample tests for mean, Student's t-test, F-test and Chi-square test,
- Correlation coefficient 'r' and its testing,
- Fitting of regression equations, Analysis of CRD, RBD and LSD.

Suggested Readings

1. Bansal M L, Singh Sukhminder, Singh Tejinderpal and Jindal Rakesh Kumar. 2014. Statistical Methods for Research Workers. Kalyani Publishers 4th edn.
2. Chandal S R S.2014. A Handbook of Agricultural Statistics. Achal Prakashan Mandir.
3. Gupta S P. 2021. Statistical Methods. Sultan Chand and Sons.
4. William G Cochran and George W Snedecor. 2014. Statistical Methods. Wiley India Pvt Ltd.

ELECTIVE COURSES

Fruit Science	
1. Production Technology of Tropical Fruit crops	3 (2+1)
2. Production Technology of Sub tropical and Temperate Fruit crops	3 (2+1)
3. Breeding of Fruit Crops	3 (2+1)
4. Canopy Management in Fruit Crops	3 (2+1)
5. Biotechnological Approaches and Micro-propagation in Fruit Crops	3 (2+1)
6. Production Technology of Arid Fruit Crops	3 (2+1)
7. Postharvest Management of Fruit Crops	2 (1+1)
Vegetable Science	
8. Production Technology of Warm Season Vegetable Crops	3 (2+1)
9. Production Technology of Cool Season Vegetable Crops	3 (2+1)
10. Production Technology of Tuber Crops	3 (2+1)
11. Breeding of Vegetable Crops	3 (2+1)
12. Biotechnological approaches and Micropropagation in Vegetable Crops	3 (2+1)
13. Postharvest Management of Vegetable Crops	3 (2+1)
14. Protected cultivation of Vegetable Crops	2 (1+1)
Floriculture and Landscaping	

FRUIT SCIENCE

SFSC 411. PRODUCTION TECHNOLOGY OF TROPICAL FRUIT CROPS 3 (2+1)

OBJECTIVES

1. To teach students origin, systematics, genetic resources, botany and production of tropical fruit crops
2. To impart adequate knowledge and skill tothe students for commercial cultivation of tropical fruit crops

THEORY

UNIT I: Importance, scope and commercial importance of tropical fruits. Distribution of tropical zones in the world and India. Origin, systematics, distribution, genetic resources, and eco-physiological requirements.

UNIT II: Major species, commercial varieties and rootstocks. Propagation, planting, training and pruning. Nutrient and water management. crop regulation, quality improvement by management practices; maturity indices, harvesting, grading, packing, storage and ripening techniques.

UNIT III: Physiological disorders, major pests and diseases and their management. Industrial and export potential, Agri. Export Zones (AEZ) and industrial support.

UNIT IV: Fruit crops- mango, papaya, pineapple, banana, avocado, sapota, guava, jackfruit, tamarind, annonas and minor fruits of tropics viz. carambola, mangosteen, pashion fruit, bilimbi, rambutan, longan and durian.

LIST OF EXPERIMENTS /PRACTICES

- Description and identification of species and varieties of tropical fruits.
- Propagation and nursery management of tropical fruit crops. Leaf sampling and nutrient analysis.
- Rejuvenation of old and unproductive trees.
- Identification and management of nutritional disorders, insect-pest and diseases.
- Maturity standards, harvesting, grading, packaging and storage.
- Visit to commercial orchards.

Suggested Readings

1. Bartholomew DP, Paull RE and Rohrbach KG. 2002. The Pineapple: Botany, Production, and Uses. CAB International.
2. Bose TK and Parthasarathy V A. 2022. Fruits: Tropical and Subtropical. Vol 14th edn. Daya Publishing House, New Delhi.
3. Chattopadhyay T K. 2013. A Textbook on Pomology Vol I-II. Kalyani Publications. New Delhi.
4. ICAR. 2019. Handbook of Horticulture (Vol I and II). ICAR Publications, New Delhi.
5. Mitra SK. 2021. Guava: Botany, Production and Uses. CAB International.
6. Paull R E and Duarte O. 2011. Tropical Fruits (Vol. 1&2). CAB International.
7. Robinson JC and Saúco VG. 2010. Bananas and Plantains. CAB International.

SFSC 412. PRODUCTION TECHNOLOGY OF SUB TROPICAL AND TEMPERATE FRUIT CROPS 3 (2+1)

OBJECTIVES

1. To familiarize the students about cultural and management practices of fruit crops
2. To impart a comprehensive knowledge and skills on quality production of fruit crops

THEORY

UNIT I: Importance, scope and commercial importance of sub-tropical and temperate fruits. Distribution of sub-tropical and temperate zones in the world and India.

UNIT II: Origin, systematics, distribution, genetic resources, and eco-physiological requirements. Major species, commercial varieties and rootstocks. Propagation, planting and HDP, training and pruning and orchard floor management.

UNIT III: Nutrient and water management, flowering and fruit set, compatibility, crop regulation, quality improvement by management practices; maturity indices, harvesting, grading, packing, storage and ripening techniques. Physiological disorders, major pests and diseases and their management.

UNIT IV: Industrial and export potential, Agri. Export Zones (AEZ) and industrial support. Fruit crops- citrus, grapes, pomegranate, litchi, loquat, grapes, litchi, pomegranate, apple, pear, peach, plum, apricot, cherries, berries, persimmon, kiwifruit, walnut, almond, pecan nut, hazelnut, chestnut, strawberry.

LIST OF EXPERIMENTS /PRACTICES

- Description and identification of varieties based on flower and fruit morphology of sub-tropical and temperate fruits.
- Canopy management. Selection of site and planting system, Mulching, Manure and fertilizer application including bio-fertilizers in fruit crops. Preparation and application of growth regulators.
- Crop regulation, maturity indices, ripening of fruits, grading and packaging.
- Production economics of sub-tropical and temperate fruits.
- Visit to commercial orchards and diagnosis of maladies.

Suggested Readings

1. Chadha KL and Shikhamany SD 1999. The Grape - Improvement, Production and Post-Harvest Management. Malhotra Book Depot, New Delhi.
2. Chattopadhyay T K. 2013. Text book on Pomology (Temperate Fruits), Volume IV. Kalyani Publishers, New Delhi.
3. Chattopadhyay T K. 2013. Text book on Pomology (Sub Tropical Fruits), Volume III. Kalyani Publishers, New Delhi.
4. Dhillon WS. 2013. Fruit Production in India. Narendra Publishing House, New Delhi.
5. Jackson D. Thiele G, Looney N E and Morley-Bunker M. 2011. Temperate and Subtropical Fruit Production. CAB International.

SFSC 413. BREEDING OF FRUIT CROPS 3 (2+1)

OBJECTIVES

1. To provide knowledge about the breeding objectives and methods of fruit breeding in a prescribed manner
2. To familiarize students with latest principles and practices of crop improvement in different fruit crops

THEORY

UNIT I: Fruit breeding-history, importance in fruit production; Major problems in fruit breeding; Plant genetic resources, their conservation and utilization in fruit crops;

UNIT II: Breeding objectives for improvement of commercial fruits (mango, citrus, guava, banana, grapes, strawberry, litchi, sapota, pomegranate, pineapple, papaya, apple, pear, peach, plum, cherry, kiwifruit, walnut, apricot, plantation crops-coconut, cocoa, tea, arecanut, coffee), their distribution, domestication and adaptation;

UNIT III: Incompatibility, sterility, parthenocarpy and apomixes; Breeding methods- introduction, colonal selection, hybridization, mutation breeding, polyploid manipulation; Rootstock breeding and improvement of quality traits;

UNIT IV: Breeding for insect-pest and disease resistance and abiotic stresses; Biotechnological interventions in fruit crop improvement.

LIST OF EXPERIMENTS /PRACTICES

- Tools and equipment of use in fruit breeding;
- Studies on bearing habits and flower structure; in-vitro pollen germination test and determination of pollen viability.
- Methods of emasculation and pollination; Hybrid seed collection, extraction and storage; hybrid seed germination;
- Raising and evaluation of segregating populations; Induction of mutations through use of physical/chemical mutagens;
- Polyploidy manipulation; Hand on practice of Emasculation and pollination in major crops of the region.

Suggested Readings

1. Badenes, M. L. and Byrne, D. H. 2012. Fruit Breeding. Springer Science, New York.
2. Dinesh, M.R. and Sankaran, M. 2022. Fruit Breeding and Genetics, New India publishing Agency, New Delhi

SFSC 414. CANOPY MANAGEMENT IN FRUIT CROPS 3 (2+1)

OBJECTIVES

1. To provide knowledge about manipulation of plant growth and development by employing different training and pruning procedures
2. To familiarize student with scientific principles of tree growth, physiology and understanding of tree response to various pruning cuts.

THEORY

UNIT I: Introduction and importance of canopy management, objectives of canopy management, importance and factors affecting canopy development. Canopy types, tree architecture and different conventional and trellis training systems.

UNIT II: Canopy manipulation for optimum utilization of light and its interception. Dwarfing physiology and high-density planting. Physical manipulation and growth regulation: Canopy management through rootstock and scion.

UNIT III: Effect of thinning and heading cuts on branch growth. Canopy management through plant growth regulators, training and pruning and management practices.

UNIT IV: Canopy development and management in relation to growth, flowering, fruiting and fruit quality in different deciduous and evergreen fruits.

LIST OF EXPERIMENTS /PRACTICES

- Study of different types of canopies, training of plants for different canopy types,
- Canopy development through pruning,
- study of different trellis training systems, development of effective canopy with support system, study on effect of different canopy types on production and quality of fruits understanding bearing behaviour.
- canopy management in different fruits, use of plant growth regulators, effect of pruning on light interception and fruit quality.
- Canopy management practices in different deciduous and evergreen fruits.

Suggested Readings

1. Bakshi JC, Uppal DK and Khajuria HN. 1988. The pruning of fruit trees and vines. Kalyani Publishers, New Delhi.
2. Chadha KL and Shikhamany SD.1999.The Grape: improvement, production and post-harvest management Malhotra Publishing House, Delhi.

SFSC 415. BIOTECHNOLOGICAL APPROACHES AND MICRO PROPAGATION IN FRUIT CROPS 3 (2+1)

OBJECTIVES

- To provide knowledge about the biotechnological interventions and micropropagation methods in a prescribed manner
- To familiarize students with biotechnological tools in fruit crops to enhance yield, biotic and abiotic stress management and improved quality traits to a considerable extent

THEORY

UNIT I: Introduction, history and basic principles of biotechnology; Physical, chemical factors and growth regulators on growth and development of plant cell, tissue and organ culture; In vitro culture and hardening:

UNIT II: callus culture – types, cell division, differentiation, morphogenesis, organogenesis, embryogenesis; Hardening and ex vitro establishment of tissue cultured plants; Transgenics,

UNIT III: Gene Technologies; Somatic cell hybridization, construction and identification of somatic hybrids and cybrids, wide hybridization; *In-vitro* pollination and fertilization, haploids, in vitro mutation, artificial seeds, cryopreservation:

UNIT IV: *In- vitro* selection for biotic and abiotic stress; use of molecular markers and genomics; Gene silencing, gene tagging, gene editing, achievements of biotechnology in fruit crops.

LIST OF EXPERIMENTS /PRACTICES

- An exposure to low cost, commercially operated and privately-owned tissue culture laboratories;
- Tasks include preparing media, inoculating explants for clonal multiplication, inducing and culturing callus, and regenerating plantlets from callus;
- Methods for sub-culturing on anther, ovule, embryo culture, and somaclonal variation; *In vitro* mutant selection against abiotic stress;
- Protoplast culture and fusion process.
- Development of large-scale mass multiplication; Project development for the establishment of a commercial tissue culture laboratory.

Suggested readings

1. Bajaj YPS. 1989. Biotechnology in agriculture and forestry. Vol. V, Fruits. Springer, USA.

2. Brown T A. 2001. Gene cloning and DNA analysis and introduction. Blackwell Publishing, USA.

3. Chahal GS and Gosal SS. 2010. Principles and procedures of plant breeding: biotechnological and conventional approaches. Narosa, New Delhi.

4. Keshavachandran R, Nazeem PA, Girija D, John PS and Peter KV. 2007. Recent Trends in Biotechnology of Horticultural Crops. Vols. I, II. NIPA, New Delhi.

5. Miglani GS. 2016. Genetic Engineering – principles, procedures and consequences. Narosa Publishing House, New Delhi.

SFSC 416. PRODUCTION TECHNOLOGY OF ARID FRUIT CROPS 3(2+1)

OBJECTIVES

1. To impart basic knowledge about the arid fruit crops
2. To familiarize students with the latest developments and trends in production technology of important arid fruit crops

THEORY

UNIT I: Importance, scope and limitations of arid and semi-arid zones, Distribution of Agro-climatic arid and semi-arid zones, soil and water conservation methods-terraces, contour bunds etc. Methods of control and impounding of run-off water - farm ponds, trenches, macro catch pits etc.

UNIT II: In-situ water harvesting methods, micro catchment, different types of tree basins etc. Methods of reducing evapotranspiration, use of shelter belts, mulches, anti transpirants, growth regulators, etc. micro systems of irrigation etc.

UNIT III: Characteristic feature of arid fruit crops, bearing habit, flowering and fruit set, improved varieties, planting techniques, propagation, canopy management, nutrient and weed management, Special production problems, insect-pests, diseases and their control measures,

UNIT IV: Post- harvest technology, harvest indices, harvesting methods, grading, packaging and storage of the following crops: ber, aonla, pomegranate, jamun, bael, date palm, phalsa, fig, custard apple, karonda, prickly pear, lasora, sea buckthorn, pistachio and wood apple

LIST OF EXPERIMENTS /PRACTICES

- Identification of various arid fruit crops,
- Planning and layout of orchards, propagation methods in arid fruit crops, training and pruning of orchard trees, preparation of fertilizer mixtures and field application, leaf sampling and nutrient analysis,
- Preparation and application of growth regulators,
- Layout of different irrigation systems,
- Identification and management of nutritional disorders, insect- pest and disease management, maturity standards, harvesting,
- Grading, packaging and storage.

Suggested Readings

1. Chattopadhyay T K 2013. A Textbook on Pomology Vol I-IV. Kalyani Publications. New Delhi.
2. Hiwale S 2015. Sustainable Horticulture in Semiarid Drylands. Springer.
3. ICAR 2019. Handbook of Horticulture (Vol I and II). ICAR Publications. New Delhi.
4. Krishna H and Sharma R R 2017. Fruit Production- Minor Fruits. Daya Publishing House.
5. Peter K V 2010. Underutilized and Underexploited Horticultural Crops. NIPA,

SFSC 417. POSTHARVEST MANAGEMENT OF FRUIT CROPS 2 (1+1)

OBJECTIVES

1. To provide knowledge about various physico-chemical changes occurring during postharvest life of fruits
2. To familiarize students with various techniques to minimize postharvest losses and maintain the postharvest quality of fruits

THEORY

UNIT I: Importance and scope. Maturity indices, harvesting practices and grading. Influence of pre-harvest practices.

UNIT II: Physiology and biochemistry of fruit ripening, ethylene evolution and its management. Pre-cooling. Factors leading to post-harvest losses.

UNIT III: Treatments prior to transportation viz. chlorination, waxing, chemicals, natural plant products, hot-water, vapour heat treatment, sulphur fumigation and irradiation.

UNIT IV: Fruit packaging and transport. Methods of storage.

LIST OF EXPERIMENTS /PRACTICES

- Analyzing maturity stages of commercially important fruit crops, harvesting methods, pre-cooling methods, grading. Components of cold and ripening chambers.
- Ripening of fruits.
- Pre- harvest and post-harvest application of growth substances, fungicides, nutrients, waxes and hot water treatments.
- Improved packing and storage of important horticultural commodities, Physiological loss in weight of fruits.
- Estimation of quality characteristics viz; TSS, titratable acidity, firmness, Vitamin C, sugars in stored fruits.

Suggested Readings

1. Kader A A. 2002. Postharvest technology of horticultural crops. 3rd edn, University of California, Agricultural and Natural Resources.
2. Wills R, McGlasson B, Graham D and Joyce DC. 2007. An introduction to the physiology and handling of Fruits, Vegetables and ornamentals, CAB International
3. Saraswathy S, Preethi TL, Balasubramanyam S, Suresh J, Revathy N and Nararajan S. 2010. Postharvest management of horticultural crops. Agrobios publication, Jodhpur.
4. Verma LR and Joshi VK. 2000. Postharvest technology of fruits and vegetables. Vol I and II.

VEGETABLE SCIENCE

1.	Production Technology of Warm Season Vegetable Crops	3 (2+1)
2.	Production Technology of Cool Season Vegetable Crops	3 (2+1)
3.	Production Technology of Tuber Crops	3 (2+1)
4.	Breeding of Vegetable Crops	3 (2+1)
5.	Biotechnological Approaches and Micropropagation in Vegetable Crops	3 (2+1)
6.	Postharvest Management of Vegetable Crops	3 (2+1)
7.	Protected Cultivation of Vegetable Crops	2 (1+1)

SVSC 411. PRODUCTION TECHNOLOGY OF WARM SEASON VEGETABLE CROPS 3(2+1)

OBJECTIVES

To impart knowledge and skills for production of warm season vegetable crops

THEORY

UNIT I: Introduction, nutritional value, origin, botany and taxonomy, important countries and states growing vegetables along with area, climate and soil requirements, commercial varieties/hybrids,

UNIT II: sowing/ transplanting time, seed rate, seed treatment, nutritional and irrigation requirements, chemical weed control, mulching, physiological disorders, harvesting techniques, postharvest management,

UNIT III: plant protection measures and seed production of warm season vegetable crops i.e. solanaceous crops, okra, cucurbitaceous crops,

UNIT IV: cowpea, sweet potato, cluster beans, amaranth, basella, moringa, tapioca. Poly-house, net- house and low tunnel technology for off-season production of summer vegetables

LIST OF EXPERIMENTS /PRACTICES

- Seed extraction, sowing practices, nursery management,
- Use of growth regulators, grafting technique, water and nutrient management.
- Drip irrigation, fertigation, weed management and mulching.
- Identification of physiological disorders, pests, diseases and nutrient deficiencies.
- Study of maturity indices.
- Forcing techniques for raising summer vegetables.
- Visit to vegetable nursery unit/ protected cultivation unit.

Suggested readings

1. Bose TK, Kabir J, Maity TK, Parthasarathy VA and Som MG. 2003. Vegetable crops. Vols. I-III. Naya Udyog.
2. Dhaliwal M S. 2017. Handbook of Vegetable Crops. Kalyani publishers, Ludhiana
3. Hazra P. 2016. Vegetable science. 2nd Ed, Kalyani publishers, Ludhiana.
4. Hazra P. 2019. Vegetable production and technology. New India Publishing Agency, New Delhi.
5. ICAR. 2002. Hand Book of Horticulture. ICAR.

SVSC 412.PRODUCTION TECHNOLOGY OF COOL SEASON VEGETABLE CROPS 3 (2+1)

OBJECTIVES

To impart knowledge and skills for production of cool season vegetable crops

THEORY

UNIT I: Introduction, nutritional value, origin, botany and taxonomy, important countries and states growing vegetables along with area, climate and soil requirements, commercial varieties/hybrids evolved by private and public sector, sowing/ transplanting time,

UNIT II: seed rate and seed treatment, nutritional and irrigation requirements, chemical weed control, mulching, physiological disorders,

UNIT III: harvesting techniques, postharvest management, plant protection measures and seed production of potato, cole crops; cabbage, cauliflower, knolkhol, broccoli, brussels' sprout, chinese

UNIT IV: cabbage, root crops; carrot, radish, turnip, beet root, bulb crops; onion and garlic, peas and beans, green leafy cool season vegetables.

LIST OF EXPERIMENTS /PRACTICES

- Seed extraction, sowing practices, nursery management, Use of growth regulators, grafting technique, water and nutrient management.
- Drip irrigation, fertigation, weed management and mulching. Identification of physiological disorders, pests, diseases and nutrient deficiencies.
- Study of maturity indices.
- Forcing techniques for raising cool season vegetables. Visit to vegetable nursery unit/ protected cultivation unit. Layout of kitchen garden.

Suggested Readings

1. Bose TK, Kabir J, Maity TK, Parthasarathy VA and Som MG. 2003. Vegetable crops. Vols. I-III. Naya Udyog.
2. Dhaliwal M S. 2017. Handbook of Vegetable Crops. Kalyani publishers, Ludhiana
3. Hazra P. 2016. Vegetable science. 2nd edn, Kalyani publishers, Ludhiana.
4. Hazra P. 2019. Vegetable production and technology. New India publishing agency, New Delhi.
5. ICAR. 2002. Hand Book of Horticulture. ICAR.
6. Thamburaj S and Singh N (Eds). 2004. Vegetables, tuber crops and spices. ICAR.

SVSC 413.PRODUCTION TECHNOLOGY OF TUBER CROPS 3 (2+1)

OBJECTIVES

To impart knowledge and skill for production of tuber crops and their management

THEORY

UNIT I: Origin, area, production, economic importance and export potential of tropical, sub-tropical and temperate tuber crops; description of varieties and hybrids.

UNIT II: Climate and soil requirement, season; seed rate; preparation of field; planting practices; spacing; water, nutrient and weed management; nutrient deficiencies.

UNIT III: Use of chemicals and growth regulators; cropping systems. Harvesting practices yield; economic of cultivation. Postharvest handling and storage, marketing.

UNIT IV: Crops to be covered- potato, sweet potato, arrow root, cassava, colocasia, xanthosoma, amorphophallus, dioscorea, Jerusalem artichoke, horse radish, coleus and yam bean and other under exploited tuber crops.

LIST OF EXPERIMENTS /PRACTICES

- Identification and description of potato and tropical, sub-tropical and temperate tuber crops; planting systems and practices; field preparation and sowing/planting.
- Top dressing of fertilizers and interculture and use of herbicides and growth regulators; identification of nutrient deficiencies,
- Physiological disorders; harvest indices and maturity standards,
- Postharvest handling and storage, marketing.
- Seed collection, working out cost of cultivation.

Suggested Readings

1. Dhaliwal M S. 2008.Handbook of Vegetable Crops. Kalyani Publishers. Ludhiana
2. ICAR. 2002. Hand Book of Horticulture. ICAR.
3. Thamburaj S. 2014. Text book of vegetable, tuber crops and Spices. ICAR, New Delhi.

SVSC 414. BREEDING OF VEGETABLE CROPS 3 (2+1)

OBJECTIVES

1. To make students well verse with the plant genetic resources and their utilization in improvement of vegetable crops
2. To impart knowledge and skill regarding breeding procedures of self-pollinated, often cross pollinated, cross-pollinated and vegetatively propagated vegetable crops

THEORY

UNIT I: Definition and history of vegetable breeding. Origin, distribution, wild relatives and breeding objective of different vegetable crops viz. tomato, brinjal, chilli, muskmelon,

UNIT II: Watermelon, cucumber, bitter gourd, pumpkin, squashes, onion, garlic, carrot, radish, cauliflower, cabbage, pea, okra and potato.

UNIT III: Plant genetic resources, their utilization and conservation. Breeding procedures of self-pollinated, often cross pollinated, cross-pollinated and vegetatively propagated vegetable crops. Conventional and modern techniques for improvement of vegetable crops. Breeding for biotic, abiotic stress tolerance and quality in vegetable crops.

UNIT IV: Genetic mechanisms for exploitation of heterosis in vegetable crops.

LIST OF EXPERIMENTS /PRACTICES

- Study of inflorescence and flower structures.
- Practice for emasculation and artificial pollination.
- Distinguished morphological characteristics of released varieties/hybrids.
- Layout of field experiments. Estimation of heterosis.
- Handling of germplasm and segregating populations by different methods like pedigree, bulk and single seed decent methods.
- Visit to vegetable seed production field.

Suggested readings

1. Allard RW. 1960. Principle of plant breeding. John Willey and Sons, USA.
2. Kalloo G. 1988. Vegetable breeding (Vol. I, II, III). CRC Press, Fl, USA.
3. Kole CR. 2007. Genome mapping and molecular breeding in plants-vegetables. Springer, USA.
4. Peter KV and Pradeep Kumar T. 1998. Genetics and breeding of vegetables. ICAR, New Delhi,
5. Prohens J and Nuez F. 2007. Handbook of plant breeding-vegetables (Vol I and II).
6. Ram H H. 2019.Vegetable Breeding: Principles and Practices. Kalyani Publishers.
7. Singh BD. 2007. Plant breeding- principles and methods. 8th edn. Kalyani Publishers, New Delhi.
8. Singh Ram J. 2007. Genetic resources, chromosome engineering, and crop improvement- vegetable crops (Vol. 3). CRC Press, Fl, USA.
9. Swarup V. 2016.Vegetable Science and Technology in India. Kalyani Publishers.

SVSC 415. BIOTECHNOLOGICAL APPROACHES AND MICROPROPAGATION IN VEGETABLE CROPS 3(2+1)

OBJECTIVES

To educate students about latest biotechnical advancements in vegetables

THEORY

UNIT I: Concepts and applications of plant biotechnology. Introduction to recombinant DNA methods: physical, chemical and Agrobacterium mediated gene transfer methods; Transgenics and its importance in crop improvement.

UNIT II: PCR techniques and its applications; DNA markers and their application - RFLP, RAPD, AFLP, CAPS, SSR etc. Marker Assisted Breeding in crop improvement.

UNIT III: Biotechnology regulations. Plant Cell and Tissue Culture - organ culture, embryo culture, cell suspension culture, protoplast culture, callus culture, anther culture, pollen culture, ovule culture and their applications;

UNIT IV: Micro-propagation methods; organogenesis and embryogenesis, Synthetic seeds and their significance; Embryo rescue and its significance. Somatic hybridization and cybrids. Soma-clonal variation and its use in crop improvement. Cryo-preservation. Application of in-vitro techniques.

LIST OF EXPERIMENTS /PRACTICES

- Preparation of solution, pH and buffers. Sterilization techniques.
- Composition of various tissue culture media and preparation of stock solutions for MS nutrient medium.
- Callus induction from various explants and plant regeneration.
- Micro-propagation, hardening and acclimatization.
- Demonstration on isolation of DNA and PCR technique.
- Demonstration of gel electrophoresis techniques and DNA finger printing.

Suggested Readings

1. Bajaj YPS (Ed.). 1987. Biotechnology in agriculture and forestry. Vol. XIX. Hitech and Micropropagation. Springer.
2. Chadha KL, Ravindran PN and Sahijram L (Eds). 2000. Biotechnology of horticulture and plantation crops. Malhotra Publ. House.
3. Debnath M. 2005. Tools and techniques of biotechnology. Pointer publication, New Delhi. Horticultural Sciences–Vegetable Science
4. Keshavachandran R. 2007. Recent trends in biotechnology of horticultural crops. New India Publ.

5. Keshavachandran R and Peter KV. 2008. Plant biotechnology; tissue culture and gene transfer. Orient and Longman, USA.

6. Keshavachandran R. 2007. Recent trends in biotechnology of horticultural crops. New-India Publication Agency, New Delhi.

7. Parthasarathy VA, Bose TK, Deka PC, Das P, Mitra SK and Mohanadas S. 2001. Biotechnology of horticultural crops. Vols. I-III. Naya Prokash. Pierik RLM. 1987. In-vitro culture of higher plants. Martinus Nijhoff Publ.

SVSC 416. POSTHARVEST MANAGEMENT OF VEGETABLE CROPS 3(2+1)

OBJECTIVES

To understand pre- and post-harvest factors responsible for deterioration in vegetable crops

THEORY

UNIT I: Determination of maturity in different vegetable crops, assessment of post-harvest losses, pre- harvest methods and practices affecting post-harvest shelf life of vegetables,

UNIT II: Mechanized harvesting of vegetables, pre-cooling of vegetables using different techniques, post-harvest chemical and non- chemical treatments to enhance shelf life,

UNIT III: Sorting and grading for packaging, ripening of vegetables, packaging of vegetables including latest techniques like MAP, storage of vegetables including latest techniques like CA storage, food safety and quality,

UNIT IV: Non-destructive methods of quality analysis, quality of raw material for processing, transportation and destination handling, marketing, treatments before shipment and storage, fresh-cut vegetables.

LIST OF EXPERIMENTS /PRACTICES

- Practices in judging the maturity of vegetables, harvesting methods and tools.
- Methods used for pre-cooling and their efficiency measurements. Post-harvest chemical treatments to extend shelf life. Sorting and grading methods.
- Ripening techniques used in climacteric vegetables.
- Traditional and latest safe storage techniques.
- Respiration measurements in harvested produce.
- Field visit to post-harvest and processing industry.

Suggested Readings

1. Chadha KL and Pareek OP. 1996. Advances in horticulture. Vol. IV. Malhotra Publ. House.

2. Chattopadhyay SK. 2007. Handling, transportation and storage of fruit and vegetables. Gene

3. Haid NF and Salunkhe SK. 1997. Postharvest physiology and handling of fruits and vegetables. Grenada Publ.
4. Mitra SK. 1997. Postharvest physiology and storage of tropical and sub-tropical fruits. CABI.
5. Paliyath G, Murr DP, Handa AK and Lurie S. 2008. Postharvest biology and technology of Fruits, vegetables and flowers. Wiley-Blackwell, ISBN: 9780813804088.
6. Ranganna S. 1997. Handbook of analysis and quality control for fruit and vegetable products. Tata McGraw-Hill.
7. Stawley JK. 1998. Postharvest physiology of perishable plant products. CBS publishers.
8. Sudheer KP and Indira V. 2007. Postharvest technology of horticultural crops. New India Publ. Agency.
9. Thompson AK (Ed.). 2014. Fruit and vegetables: harvesting, handling and storage (Vol. 1 and 2) Blackwell Publishing Ltd, Oxford, UK. ISBN: 9781118654040.
10. Verma LR and Joshi VK. 2000. Postharvest technology of fruits and vegetables: handling, processing, fermentation and waste management. Indus Publishing Company, New Delhi, India. ISBN 8173871086.
11. Wills RBH and Golding J. 2016. Postharvest: an introduction to the physiology and handling of fruit and vegetables, CABI Publishing, ISBN 9781786391483.
12. Wills RBH and Golding J. 2017. Advances in postharvest fruit and vegetable technology, CRC Press, ISBN 9781138894051

SVSC 417. PROTECTED CULTIVATION OF VEGETABLE CROPS 2(1+1)

OBJECTIVES

To provide technical know-how to students for raising vegetables under protected structures

THEORY

UNIT I: Protected cultivation- importance, scope and constraints, status of protected cultivation in India and world. Soil/substrate preparation and management.

UNIT II: Classification and types of protected structures. Irrigation and fertigation management. Propagation and production of quality planting material of horticultural crops.

UNIT III: Greenhouse cultivation of important horticultural crops viz., tomato, bell pepper, cucumber, lettuce, brinjal. Off season production of vegetables. Hydroponics, aeroponics system of cultivation, Insect pest and disease management.

UNIT IV: Use of protected structures for seed production; Economics of greenhouse crop production

LIST OF EXPERIMENTS /PRACTICES

- Identification of different protected structures, Use of pro-trays in quality planting material production, Identification of different growing media/ substrates,
- Raising of seedlings and saplings under protected cultivation, Bed preparation, planting and intercultural operations for crop production,
- Estimation and management of soil EC, Estimation and management of pH in media/ substrates,
- Scheduling of irrigation in different horticultural crops,
- Fertilizer management through drip irrigation,
- Control of disease and insect pests in protected structures, fumigation techniques.
- Visit to commercial protected cultivation units.

Suggested Readings

1. Chandra S and Som V. 2000. Cultivating vegetables in green house. Indian Horticulture 45:17
2. Parvatha RP. 2016. Sustainable crop protection under protected cultivation. E-Book Springer. Prasad S and Kumar U. 2005. Greenhouse management for horticultural crops. 2nd edn. A Grobios.
3. Singh B. 2005. Protected cultivation of vegetable crops. Kalyani publishers, New Delhi.
4. Singh DK and Peter KV. 2014. Protected cultivation of horticultural crops (1st edn). New India Publishing Agency, New Delhi.
5. Singh S, Singh B and Sabir N. 2014. Advances in protected cultivation. New India Publishing Agency, New Delhi.
6. Tiwari GN. 2003. Green house technology for controlled environment. Narosa publ. house.

Floriculture and Landscaping

1.	Turf Management	2 (1+1)
2.	Protected Cultivation of Flower Crops	3 (2+1)
3.	Value Addition in Floriculture	3 (2+1)
4.	Breeding of Ornamental Crops	3 (2+1)
5.	Principles of Landscape Architecture	3 (2+1)
6.	Commercial Floriculture and Landscaping	3 (2+1)
7.	Postharvest Handling of Floriculture Crops	3 (2+1)

SFLA 411. TURF MANAGEMENT 2(1+1)

OBJECTIVES

1. To impart hands-on training on practical aspects of turf management practices
2. To impart entrepreneurial skills in turf establishment

THEORY

UNIT I: History, present status and prospects of turf industry; basic requirements, site selection and evaluation, concepts of quality of soil pertaining to turf grass establishment, criteria for evaluation of turf quality. Types, species, varieties, important breeders, grasses for different locations and conditions and their compatible groupings as per climatic conditions;
UNIT II: Turfing for roof gardens. Turf establishment methods such as seeding, sprigging/dibbling, plugging, sodding/turfing, turf plastering, instant turfing (portable), hydro-seeding, Turf management.

UNIT III: Irrigation, drainage, nutrition, special practices like aerating, rolling, coring, dethatching, verti-cutting, soil topdressing, use of plant growth regulators and micronutrients, Turf mowing – mowing equipment, techniques to minimize wear and compaction, weed control, biotic and abiotic stress management in turfs, standards for turf, use of recycled water etc.,

UNIT IV: Making of different sports arenas: Establishment and maintenance of turfs for playgrounds, viz. golf, football, hockey, cricket, residential and public parks, turfing of Govt. and Corporate office gardens, turf colourants.

LIST OF EXPERIMENTS /PRACTICES

- Identification of turf grasses and turf machinery, Soil preparation,
- turf establishment methods, provision of drainage, Layout of macro and micro irrigation systems,
- Water and nutrient management, Special practices – mowing, raking, rolling, soil top dressing, weed management,

- Biotic and abiotic stress management,
- Project preparation for turf establishment,
- Visit to parks and golf courses, corporate, Govt. organizations, Rejuvenation of lawns, Turf economics.

Suggested Readings

1. Jankiram, T, Namita and Jain Ritu. Introduction to Turfgrasses. 2015. 1st edn. Westville publishing house.
2. Nick E. 2016. Christians Fundamentals of Turfgrass Management. 5th edn, Aaron J. Patton, Quincy D. Law. Published by Wiley
3. Tiwari A K, Singh, K P, Shephalika Amrapali, Girish, K S and Singh Premjit. 2015. Lawn Management. ICAR-Directorate of Floricultural Research, Pune-411005 (Maharashtra).

SFLA 412. PROTECTED CULTIVATION OF FLOWER CROPS 3 (2+1)

OBJECTIVES

1. To enable regulation of flowering under protected cultivation
2. To impart skills in formulating the project on protected cultivation of flower crops

THEORY

UNIT I: Prospects and types of protected structures: Prospects of protected floriculture in India; Types of protected structures – Glasshouse/polyhouse, shade net houses, mist chambers, lath houses, orchidarium, fernery, rain shelters etc.

UNIT II: Principles of designing and erection of protected structures; Low cost/Medium cost/High-cost structures; Structural components; Suitable flower and foliage plants for protected cultivation.

UNIT III: Microclimate management and manipulation of temperature, light, humidity, air and CO_2; Heating and cooling systems, ventilation, naturally ventilated greenhouses, fan and pad cooled greenhouses, light regulation, containers and substrates, media, soil decontamination, layout of drip and fertigation system, water and nutrient management, IPM and IDM, Crop regulation by chemical methods and special horticultural practices (pinching, disbudding, deshooting, deblossoming, etc.); Staking and netting, Photoperiod regulation.

UNIT IV: Automation in greenhouses, sensors, solar greenhouses and retractable greenhouses, Export standards, MDH guidelines for erection of protected structure, APEDA regulations for export. Crops: Rose, Chrysanthemum, Carnation, Gerbera, Orchids, Anthuriums, Lilium, Alstromeria, etc.

LIST OF EXPERIMENTS /PRACTICES

- Study of various protected structures, Design, layout and erection of different types of structures,
- Practices in preparatory operations, growing media, soil decontamination techniques, Microclimate management,
- Practices in drip and fertigation techniques, special horticultural practices,
- Determination of harvest indices and harvesting methods,
- Postharvest handling, packing methods, Economics of cultivation,
- Project preparation, Project Financing guidelines,
- Visit to commercial greenhouses.

Suggested Readings

1. Tyagi S and Sahay S 2020. Protected cultivation of flowers 2020 NIPA, New Delhi.
2. Singh Mahesh Chand and Sharma, K K. 2024. Protected Cultivation: Structural design, crop management, modelling and automation. CRC Press.

SFLA 413. VALUE ADDITION IN FLORICULTURE 3 (2+1)

OBJECTIVES

1. To study different methods of value addition like drying, flower arrangements, oil extraction, etc.
2. To prepare value added products from flower crops

THEORY

UNIT I: Scope and prospects of value addition, Types of value-added products, techniques of value addition including tinting. Value addition in loose flowers and product development- Gulkhand, floral tea, rose oil, rose water, Pankhuri, floral dyes, rose sherbet, floral ice creams, sweets, etc. Flower arrangement, styles, ikebana schools (ikenobo, ohara, sogetsu etc), Ikebana- moribana, nagiere, contemporary style.

UNIT II: Dry flowers– Identification and selection of flowers and plant parts; tips for collecting dry flower making, selection of stages for picking of flowers for drying, Techniques in dry flower making – Drying, glycerising, bleaching, dyeing, embedding, pressing.

UNIT III: Designing and arrangement – dry flower baskets, bouquets, pot-pourri, wall hangings, button holes, greeting cards, wreaths; petal embedded handmade papers. Post drying management including moisture, pests and molds. Essential oils; Selection of species and varieties (including nonconventional species), extraction methods,

UNIT IV: Packing and storage, Aromatherapy. Types of pigments, carotenoids, anthocyanins, chlorophyll, betalains; Significance of natural pigments as nutraceuticals, Extraction methods and applications in food, pharmaceutical and poultry industries. Synthetic and Natural dyes, dying techniques, colour retention.

LIST OF EXPERIMENTS /PRACTICES

- Practices in preparation of different type of flower arrangements including bouquets, button- holes, flower baskets, corsages, floral wreaths, garlands with fresh flowers,
- Techniques in flower arrangement and floral decoration,
- Identification of plants for dry flower making,
- Practices in dry flower making; Preparation of dry flower baskets, bouquets, potpourri, wall hangings, button holes, greeting cards, wreaths, etc.
- Essential oil extraction units, Extraction of pigments, V
- Vsit to dry flower units, Economics of value-added products.

Suggested Readings

1. De LC. 2019. Value Addition in Flowers and Orchids- New India Publishing Agency.

2. Gupta Sachi, Pathak Sanjay and Yadav Atul. 2019. Advances and value addition in flower crops.

SLFA 414. BREEDING OF ORNAMENTAL CROPS 3 (2+1)

OBJECTIVES

1. To teach the students crop specific breeding
2. To teach the students about the varieties evolved in flower crops through various methods and institutions

THEORY

UNIT I: Origin, evolution, distribution, introduction, domestication and conservation of ornamental crops. Unit II: Introduction and initiatives in IPR and PBR of ornamental crops. Breeding objectives, reproductive barriers (Male sterility, incompatibility) in major ornamental crops.

UNIT II: Inheritance of important traits, Genetic mechanisms associated with flower colour, size, form, doubleness, fragrance, plant architecture, post-harvest life, abiotic and biotic stress tolerance/ resistance. Breeding methods suitable for sexually, asexually propagated flower crops,

UNIT III: Self- and cross- pollinated crops- pedigree selection, backcross, clonal selection, polyploidy and mutation breeding, heterosis and F1 hybrids. Role of biotechnology in improvement of flower crops including somaclonal variation,

UNIT IV: In vitro mutagenesis, genetic engineering, molecular markers etc., Crops- rose, chrysanthemum, carnation, gerbera, gladiolus, orchids, anthurium, lilium, marigold, jasmine, tuberose, dahlia, gaillardia, crossandra, aster etc., Flowering annuals: petunia, zinnia, snapdragon, stock, pansy, calendula, balsam, dianthus etc.

LIST OF EXPERIMENTS /PRACTICES

- Floral biology of important ornamental crops, Cytology and cytogenetics.
- Selfing and crossing procedures for important ornamental crops.
- Evaluation of hybrid progenies.
- Induction of mutants through physical and chemical mutagens.
- In vitro selection, genetic engineering and Induction of polyploidy, DUS testing.

Suggested Readings

1. De LC. 2019. Ornamental Crop Breeding. Aavishkar Publishers Jaipur, Rajasthan.
2. Singh BD. 2006. Plant Breeding: Principles and Methods. Kalyani Publishers.

SFLA 415. PRINCIPLES OF LANDSCAPE ARCHITECTURE 3 (1+2)

OBJECTIVES

1. To familiarize students with basics of Auto-CAD software
2. To impart skills in preparation of garden designs

THEORY

UNIT I: Historical Importance of Indian gardens, Gardens of ancient world, Definitions, Famous gardens of India and abroad, formal, informal, free style and wild gardens, basic themes of gardens viz. circular, rectangular and diagonal themes,

UNIT II: Steps in preparation of garden design. Use of Auto CAD in designing gardens. Factors affecting landscape design viz. initial approach, view, human choice, simplicity, topography etc., Principles of Landscape gardens viz. Axis, rhythm, balance, texture, form, mass effect, focal point, mobility, emphasis, unity and harmony etc.

UNIT III: Elements of landscape gardens. Bio-aesthetic planning, definition, objectives, Planning and designing of home gardens, colonies, countryside planning, urban landscape.

UNIT IV: Development of institutional gardens, planning and planting of avenues, beautifying schools, railway stations, bus stands, air ports corporate buildings, river banks, play grounds.

LIST OF EXPERIMENTS /PRACTICES

- Study of gardens, tools and implements. Use of drawing equipment, graphic symbols and notations in landscaping designing, Study and designing of different styles of gardens,
- Study and designing of gardens based on different themes,
- Designing gardens using Auto-cad,
- Designing gardens for home, traffic islands, schools and colleges, public buildings, factories, railway stations, air ports, religious places, play grounds, corporate buildings/ malls.
- Designing and planting of avenues for state and National highways, Design and establishment of Japanese, English and Mughal gardens.

  Visit to public, institutional and botanical gardens.

Suggested readings

1. Arora, J.S. 2010. Introductory Ornamental Horticulture. Kalyani Publishers. 6th edn, pp.230.
2. Randhawa, G. S. and Mukhopadhyay, A. 2001. Floriculture in India. Allied Publishers, pp 660.

SFLA 416. COMMERCIAL FLORICULTURE AND LANDSCAPING 3(2+1)

OBJECTIVES

- To learn about production technology, propagation, and cultural practices and packaging and marketing of various flower crops
- To learn generating the planting material and their practical use in different landscaping projects

THEORY

UNIT I: Scope, importance and export potential of floriculture, environment factors influencing plant growth and flower production in cut flowers and cut greens. Production technology including varieties, propagation, soil, nutrition, disease and pests of important cut flowers.

UNIT II: Post harvest handling, grading and packing cut flowers, pot and bedding plants. Flower seed production. Cost of production of commercially important flowers. History of gardening, characteristics of Hindu, Mughal, Japanese and English gardens.

UNIT III: Principle groups of plants like trees, shrubs, climbers, shade loving plants, ground covers, their analysis and use in landscape composition. Principles of art and landscaping. Preparation of landscape plans for homes, farm complexes, small parks and institutions.

UNIT IV: Development and maintenance of rock, water and terrace gardens. Bonsai and dish gardens, project formulation and evaluation.

LIST OF EXPERIMENTS /PRACTICES

- Preparation of plans and laying out of gardens.
- Identification of planting material and commercial varieties of flowers. Seed collection, germination tests and storage.
- Harvesting and handling of cut flowers. Judging of flowers and pot plants. Visit to local nurseries and florist centers.

Suggested readings

1. Arora, J.S. 2010. Introductory Ornamental Horticulture. Kalyani Publishers. 6th edn, pp. 230.
2. Randhawa, G. S. and Mukhopadhyay, A. 2001. Floriculture in India. Allied Publishers. pp 660.

SFLA 417. POSTHARVEST HANDLING OF FLORICULTURE CROPS 3(2+1)

OBJECTIVES

1. To teach the students about various factors leading to postharvest losses in flowers
2. To acquaint the students about various technologies (like conditioning, grading, storage, packaging etc) used in postharvest management of flowers
3. To provide hand on training to students for postharvest handling of commercial flowers

THEORY

UNIT I: Importance of Postharvest Technology in Floricultural crops, Physiology of flowering in relation to photoperiodism, temperature and other environmental factor. Structural, biochemical, metabolic and hormonal changes during flower senescence. Factors affecting postharvest quality of flowers- pre harvest, harvest and postharvest.

UNIT II: Causes of decline in post-harvest life of flowers. Floral preservatives - holding, pulsing and budding. Plant hormones and their role in postharvest management of flowers.

UNIT III: Storage, its types and factors affecting storage. Grading of different flowers. Packaging – passive and active. Importance of cool chain in transportation of cut flowers.

UNIT IV: Physiological disorders of flowers. Latest approaches to improve postharvest life of flowers. Postharvest handling of commercial flowers- Rose, Chrysanthemum, Gladiolus, Lilium Tuberose and marigold.

LIST OF EXPERIMENTS /PRACTICES

- Photoperiodism and vernalization in flowering.
- Membrane integrity and water relation during senescence.
- Harvest and postharvest factors affecting postharvest quality of flowers.
- Preparations of different solutions. Holding and pulsing solutions.
- Wet and dry storage. Grading of flowers. Types of packaging.
- Physiological disorders of flowers and their remedial measures.
- Postharvest handling of commercial flowers- Rose, Chrysanthemum, Gladiolus, Lilium Tuberose and marigold.

Suggested Readings

1. Bhattacharjee, SK and De, LC. 2004. Advances in Ornamental Horticulture Vol. V, Pointer publishers, Jaipur.
2. Bose, TK and Yadav, LP. 1989. Commercial Flowers. Naya Prokash, Kolkata.
3. Bose, TK, Maiti, RG, Dhua, RS and Das, P. 1999. Floriculture and Landscaping. Naya Prokash.
4. Larson, RA and Armitage, AM. 1992. Introduction of Floriculture. International Book Distributing Co., Lucknow, India.
5. Nowak, J and Rudnicki, RM. 1990. Postharvest handling and storage of cut flowers, florist greens, and potted plants. Timber Press, USA. pp. 210.

SKILL ENHANCEMENT COURSES (SEC modules)

SL.No.	COURSE CODE	COURSE TITLE	CREDIT
SKILL ENHANCEMENT COURSES			
1	SECH.111	Mushroom cultivation	2(0+2)
2	SECH.112	Apiculture	2(0+2)
3	SECH.123	Orchard floor management	2(0+2)
4	SECH.124	Landscape gardening	2(0+2)
5	SECH.125	Post harvest management of horticulture produce	2(0+2)
6	SECH.126	Seed production techniques in vegetable crops	2(0+2)
		TOTAL	**0+12=12**

ONLINE COURSES

- The students will choose 10 credit online (as per UGC guidelines for online courses) as a partial requirement for the B.Sc. (Hons.) Horticulture degree program. These can be taken any time during the whole span of the degree program as per choice of students.
- The online courses can be for many field such as Horticulture, Basic Sciences, Humanities, Economics, 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-gradial as separate certificates would be issued by institutes offering the courses.
- The MOOC courses taken by the student will be separately registered/approved at the University level.
- The University/ institute will keep a record of such courses registered and completed by each student and will indicate the title of the (satisfactorily completed) courses in final transcript issued to the student.

QUESTION PAPER PATTERN

Course Title:

PART A

I . CHOOSE THE APPROPRIATE ANSWER 0.5M X 25 =12.5M

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II. STATE TRUE OR FALSE 0.5MX15=7.5M

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III. MATCH THE FOLLOWING **0.5M X10= 5M**

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PART B

IV. ANSWER ANY FIVE OF THE FOLLOWIG **2M X 5= 10M**

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V. ANSWER ANY THREE OF THE FOLLOWING **5M X 3= 15M**

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61.