



**ANNAMALAI UNIVERSITY**

(Accredited with 'A' Grade by NAAC)

**FACULTY OF AGRICULTURE**

(Accredited by ICAR)



**DEPARTMENT OF HORTICULTURE**

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**Academic Regulations and Syllabi**

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**DOCTOR OF PHILOSOPHY IN  
PLANTATION, SPICES, MEDICINAL AND  
AROMATIC CROPS**

**Under Choice Based Credit System (CBCS)  
with Outcome based Education**

**2022-2023 Onwards**

# COMMON REGULATIONS FOR ALL Ph.D. PROGRAMMES OF FACULTY OF AGRICULTURE

*(w.e.f. 2022-2023)*

## 1. DEFINITIONS

1.1 An “**Academic year**” shall consist of two semesters.

1.2 “**Semester**” means an academic term consisting of 110 instructional days excluding final theory examinations.

1.3 “**Course**” means a unit of instruction to be covered in a semester having specific No., title and credits.

1.4 “**Credit hour**” means, one hour lecture plus two hours of library or homework or two and half hours of library/field practical per week in a semester.

1.5 “**Credit load**” of a student during a semester is the total number of credits registered by that student during that particular semester.

1.6 “**Grade Point**” of a course means the value obtained by dividing the percentage of marks earned in a course by 10 and the Grade Point is expressed on a 10 point scale and rounded off to two decimal places.

1.7 “**Credit Point**” means the grade point multiplied by corresponding credit hours.

1.8 “**Grade Point Average (GPA)**” means the quotient of the total credit points obtained by a student in various courses at the end of each semester, divided by the total credit hours taken by the student in that semester. The grading is done on a 10 scale and the GPA has to be corrected to two decimals.

1.9 “**Overall Grade Point Average (OGPA)**” means the quotient of cumulative credit points obtained by a student in all the courses taken from the beginning of the first semester of the year divided by the total credit hours of all the subjects which he/she had completed up to the end of a specified semester and determines the overall performance of a student in all subjects during the period covering more than one semester. The OGPA has to be arrived at the second decimal place.

## 2. SYSTEM OF EDUCATION

2.1 These rules and regulations shall govern the Ph.D. programmes leading to the award of Degree of Doctor of Philosophy in the concerned subject in the Faculty of Agriculture, Annamalai University. They shall come into force with effect from the academic year 2022-2023.

2.2 The semester system shall be followed for all the Ph.D. degree programmes. The duration of doctoral programmes is as follows:

2.2.1 The duration of the programme and the time for admission of thesis are counted from the date of provisional registration.

2.2.2 The minimum duration of the programme is three years and the maximum duration of the programme shall be seven years.

2.2.3 Break of study shall be granted up to a maximum period of one year and it can be done only after completing the course work. Such request shall be made in advance by scholar in writing with the recommendation of Supervisor, Head of the Department (HoD) and Dean, Faculty of Agriculture and it should reach the Director, Directorate of Academic Research (DARE). The orders for the break of study shall be issued by the Director, DARE after assessing the need.

2.2.4 If prior permission is not sought and obtained, it will be considered as a case of discontinuation and action will be taken to cancel the registration of such scholars.

2.2.5 The scholars should remit the yearly fees during the break of study also.

### **3. PROGRAMMES OFFERED**

The details of various Ph.D. programmes offered in the Faculty of Agriculture are as follows:

1. Agri Business Management
2. Agricultural Economics
3. Entomology
4. Agricultural Extension Education
5. Agricultural Microbiology
6. Agronomy
7. Genetics and Plant Breeding
8. Horticulture in Fruit Science
9. Horticulture in Vegetable Science
10. Horticulture in Floriculture and Landscaping
11. Horticulture in Plantation, Spices, Medicinal and Aromatic plants
12. Molecular Biology and Biotechnology
13. Plant Pathology
14. Seed Science and Technology
15. Soil Science

### **4. ELIGIBILITY FOR ADMISSION**

Candidates seeking admission to Ph.D. programme should satisfy the following requirements.

4.1 Candidates with two year master's degree programmes from Universities recognized by Annamalai University are eligible to apply for Ph.D. programmes of the university (Table 1).

4.2 Candidates who have undergone the programme under conventional system should possess not less than a second class Master's degree. The candidates under trimester system should possess a minimum OGPA of 3.00 out of 4.00. For those under semester system 7.00 out of 10.00 is required for various Doctoral programmes.

**Table 1: Eligibility Criteria**

<b>Doctoral Degree Programmes</b>	<b>Eligibility</b>
1. Agri Business Management	MBA in Agribusiness / MBA Agri Business Management
2. Agricultural Economics	M.Sc. (Ag.) in Agrl. Economics / Agricultural Marketing Management
3. Entomology	M.Sc. (Ag.) in Entomology / Agricultural Entomology
4. Agricultural Extension Education	M.Sc. (Ag.) in Agricultural Extension / Agricultural Extension and Communication / Agricultural Extension Education / Extension Education
5. Agricultural Microbiology	M.Sc. (Ag.) in Agricultural Microbiology
6. Agronomy	M.Sc. (Ag.) in Agronomy
7. Genetics and Plant Breeding	M.Sc. (Ag.) in Genetics and Plant Breeding
8. Horticulture	M. Sc (Ag.) Hort. / M.Sc. (Hort.) / M.Sc. (Hort.) in Fruit Science / Vegetable Science / Floriculture and Landscape Gardening or Architecture / Plantation, Spices, Medicinal and Aromatic Crops
9. Plant Molecular Biology and Biotechnology	M.Sc. (Ag.) in Plant Molecular Biology / Agricultural Biotechnology
10. Plant Pathology	M.Sc. (Ag.) in Plant Pathology
11. Seed Science & Technology	M.Sc. (Ag.) in Seed Science & Technology
12. Soil Science	M.Sc. (Ag.) in Soil Science

4.3 All research scholars shall undergo course work for two semesters as prescribed by the Department. Duration of the programme will be for three years.

4.3.1 The Ph.D. scholars shall report in the Department and sign every day in the attendance register. In order to promote quality research and training in cutting edge areas, the University may permit the scholar to pursue his research work in Annamalai University or in other Universities/Research Institutes by entering with/without MOU between Annamalai University and the partner University/Institute after the completion of qualifying Viva voce examination.

4.3.2. Project staff/ fellow working in projects in the University, sponsored by Government of India/ Industries / Government of Tamil Nadu can also register.

4.3.3. Candidates in employment should be sponsored by their employer and should avail leave for the minimum duration of the programme and should be formally relieved from their duty to register.

4.3.4. Candidates who are selected under the national level fellowship programmes or by any recognized bodies and who satisfy the eligibility conditions as per the regulations shall apply in the respective discipline.

4.3.5. Admission to Foreign Students: Foreign students, who are selected under various scholarship schemes, either by the Ministry of Education and Culture or by the Ministry of External Affairs, will be given admission on the recommendation / sponsorship of the

respective Ministry of Government of India. The other foreign students who seek admission should possess a research VISA issued by the Indian Embassies abroad and produce “No Objection Certificate” from the Ministry of Human Resource Development, Government of India, after clearance from the Ministry of External Affairs. They should also show proof for financial capability for staying, pursuing Ph.D. programme for three years.

## 5. MODE OF SELECTION

5.1. University shall issue notification for Ph.D. admission once in a year.

5.2. The candidates desirous of registering for Ph.D. programme shall apply by filling all the relevant details mentioned in the online application form posted in the University website and submit completed application online before the due date as indicated in the notification issued from time to time.

5.3 Incomplete applications and applications with false information in any respect shall be summarily rejected without any intimation to the candidate.

5.4. The Departmental Research Committee (hereafter referred to as DRC) of concerned Department shall screen the applications as per the eligibility norms and shall conduct the written test and interview only for eligible candidates.

5.5. The admission to Ph.D. students shall be based on the following criteria besides general eligibility.

5.5.1 An entrance test at post graduate level for 70 marks (70 multiple choice questions (MCQs), each question carrying one mark and duration of the test is 90 minutes followed by an interview that will have a weightage of 30 marks.

5.5.2 The candidates who secure 50% marks in entrance test and interview are eligible for admission.

5.5.3 A relaxation of 5 % marks (from 50 % to 45%) shall be allowed for the candidates belonging to SC/ST/OBC (non creamy layer)/ differentially able category.

5.5.4 Candidates with UGC- JRF / NET / ICAR/ICSSR qualified candidates and teacher fellowship holders are exempted from the Entrance test but they have to appear for the interview and evaluated for 100 marks.

5.6 Departmental Research Committee: The following is the constitution of the DRC. The members other than Head of the Department shall serve only for one academic year.

<b>Designation</b>	<b>Members</b>
Head of the Department	Convener
Two professors/ Senior Faculty nominated by the Vice-Chancellor in rotation	Members
One Associate Professor (in rotation)	Member
One Assistant Professor (in rotation)	Member

5.7. The DRC has the following functions

- 5.7.1 Selection of candidates for admission to the Ph.D. programme.
- 5.7.2 Facilitating research facilities in the Department.
- 5.7.3 Maintenance of research quality and quality of publications.
- 5.7.3 Sorting out any other research related issue of the Department.

5.8. If there is any dispute either in the constitution or functioning of the DRC, it shall be brought to the notice of the Director, DARE and the decision of the Vice-Chancellor shall be final.

5.9. The minutes of the DRC together with the list of selected candidates and their research supervisors along with recommendations of the Dean of the respective faculty will be placed before the Vice-Chancellor for approval.

## **6. ADMISSION**

- 6.1. The selected candidates shall be issued admission cards and they will be admitted to Ph.D. programme in the respective Department based on his/her PG qualification, entrance and interview.
- 6.2. The provisional registration order for Ph.D. shall be issued to the candidates.
- 6.3. The scholar, supervisor, Research Advisor Committee members and examiners shall not be relatives to one another.

## **7. TUITION FEES AND OTHER FEES**

- 7.1 The selected candidates shall pay the prescribed fees before the last date mentioned in the selection order, failing which they will forfeit the seats.
- 7.2. The yearly fees shall be paid by the scholars within the prescribed date till the scholar submits the thesis. The supervisors should monitor the regular payment of yearly fees by those scholars who are working under them.
- 7.3. The registration is liable for cancellation, if the research scholar has not paid the yearly fees within stipulated time.
- 7.4 Non-payment of yearly fees is a serious lapse on the part of the scholars. Explanation for non-payment of yearly fees shall be called for from the supervisors.
- 7.5 The various fees payable by the students will be decided by the university from time to time.
- 7.6 Admission to the hostel will be strictly restricted to the actual accommodation available and no associate will be allowed. A Ph.D. student may be allowed to stay in the hostel for a maximum of five years from the date of admission to the Ph.D. programme.

## **8. CREDIT GRADE POINT REQUIREMENTS**

- 8.1. A student enrolled for Doctoral program is required to complete 100 credits inclusive of 75 credits of research to become eligible for the degree as detailed below:

Sl. No.	Details	Credit Hours
1	Major Courses	12
2	Minor Courses	6
3	Supporting Courses	5
4	Seminar	2
5	Research	75
	Non credit Compulsory courses	
	Research and Publication Ethics (Contact hours: 2)	
	MOOC (Contact hours: 2)	
	<b>Total</b>	<b>100</b>

8.2. In a semester, a Ph.D. scholar can register a maximum of 15 credits excluding research. However, the research credits registered should not exceed 16 per semester. Semester-wise distribution of credits is given in the respective Ph.D. programmes.

8.3. Registration Card: A student shall register the courses offered in a semester by writing all the courses in registration card in quadruplicate. The Supervisor, Ph.D. Coordinator and Head of the Department are responsible to furnish the registration particulars of the students with their signature in the Registration card to the Dean. The Dean shall approve the registration cards. The approved registration cards shall be maintained by the HoD, Supervisor and the student concerned. The list of courses registered by the students in each semester shall be sent by the Dean to the DARE for preparation of Report Cards.

8.4. The Ph.D. students should complete their course work within the first two semesters in Annamalai University campus.

8.5. Requirements for Ph.D. programme shall also include successful completion of Non-Credit Compulsory Courses, thesis research in the major field of study and submission of thesis thereon.

## 9. ATTENDANCE REQUIREMENT

9.1 One hundred per cent attendance is expected from each scholar. A student who fails to secure 80 per cent of attendance in each subject separately for theory and practical, shall not be permitted to appear for the final examination in that subject and shall be awarded 'E' (incomplete) and will be required to repeat the course whenever offered.

9.2 In respect of the student who has absented himself / herself for classes with or without valid reasons, that period will be treated as absence only and not as leave. Also, no attendance will be given for writing make up tests.

9.3 In case of new admission, for calculating 80 percent attendance in the first semester, the number of working days will be calculated from the date of joining of the students who are permitted to join late due to administrative reasons. However, for genuine reasons, condonation of attendance deficiency may be considered by the Vice - Chancellor on the

recommendation of the Research Advisory Committee, HoD and Dean, Faculty of Agriculture on payment of condonation fee prescribed by the university.

9.4 Students absenting from the classes with prior permission of the HoD on official University business shall be given due consideration in computing attendance.

9.5 In respect of students who had absented for the mid-semester examination (MSE) on university business with prior permission of the HOD and Dean, Faculty of Agriculture, the makeup first test should be conducted ordinarily within 15 working days from the date of conduct of the first test.

9.6 The students who absent himself/herself for first test in a subject on genuine reasons shall be permitted on the recommendation of the course teacher / Research Supervisor and Head of the Department concerned. Missing examination should be completed within 15 working days from the date of respective examination on payment of missing examination fee prescribed by the university.

## **10. RESEARCH ADVISORY COMMITTEE**

10.1 Each Ph.D. scholar shall have a Research Advisory Committee (RAC) to guide the scholar in carrying out his/her programme.

10.2 A Research Advisory Committee shall be constituted with the approval of the University for each candidate separately, immediately after his/her admission. The purpose of the RAC is to provide expert opinion on frontline research.

10.3 There shall be a Research Advisory Committee for every student consisting of not fewer than four members with the Supervisor as Chairperson. The Research Advisory Committee should have representatives from the major and minor fields. The major **Advisor/Research Advisor** will be from Annamalai University and Co-Research Supervisor will be from the partner institutes (Research Scholars pursuing in other institutes/universities) besides RAC members.

The Research Supervisor should convene a meeting of the Research Advisory Committee at least once in a semester. The research credit evaluation form should be communicated to the Head of Department and the Director, DARE for information.

### **10.4 Research Supervisor**

10.4.1 Every scholar shall have a Research Supervisor (among the recognized guides), who will be appointed by the Vice-Chancellor on the recommendation of the DRC, Head of the Department and the Dean, Faculty of Agriculture. Research supervisors approved by the Vice-Chancellor only can be the guide for the students.

10.4.2 A teacher having Ph.D. with 5 years of service and PG teaching is eligible for teaching and guiding Ph. D. scholars. A teacher should have a minimum of three years of service before retirement for allotment of doctoral candidates.

10.4.3 The research supervisors who wish to avail leave/lien/deputation beyond a period of six months shall propose a Co-supervisor in the concerned subject for the candidates registered with them and it may be intimated to the University well in advance. The final approval of the proposal rests with the Vice-Chancellor.



## **10.5 Functions of the RAC:**

10.5.1 Discuss, advice and recommend on all matters connected with the scholar's research from admission till the completion of the programme.

10.5.2 Approve the topic of research and the synopsis.

10.5.3 Assess and approve the progress reports of Ph.D. scholars in the prescribed format and to report to the University on the fitness or otherwise of the candidate to proceed with his/her research work for the Ph.D.

10.5.4 If necessary, recommend and approve change of title of dissertation / thesis and change of Research Supervisor.

10.5.5. Conduct the pre-submission presentation (before the submission of synopsis) and to give a certificate to this effect to be submitted along with the synopsis.

10.6 The Research Advisory Committee will meet every semester

10.6.1 To scrutinize the research proposal / progress report submitted by the research scholar.

10.6.2 To assess the conduct of experiments / field work, peruse laboratory notebooks, data recording, analysis, and publication.

10.6.3 To review and endorse the annual progress report of the research scholar.

10.6.4 To approve the synopsis of the thesis.

10.6.4 The Chairperson will convene the Research Advisory Committee meetings with intimation to the Director, DARE through the Head of the Department.

## **10.7 Changes in RAC**

The proposals for changes in the RAC are to be sent to the Director, DARE, through HOD and Dean for approval, if it is keenly felt that such changes are absolutely necessary.

## **10.8 Change of Research Supervisor**

10.8.1 Change of Research Supervisor shall not be permitted as a routine. In exceptional cases, such change may be permitted, if valid reasons are provided by the candidates. The Committee headed by the Vice-Chancellor shall look into the request of the petitioner, if there is any conflict between the scholar and the research supervisor.

10.8.2 The Research Supervisor under whom the scholar has originally registered shall give a "No Objection Certificate" and the new proposed Research Supervisor should give a "Certificate of Willingness" to guide the candidate. The final decision will rest with the University. However, the Vice-Chancellor, on the recommendation of the RAC and Dean's Committee, has the right to assign a new research supervisor to the research scholar.

10.8.3 When the change of Research Supervisor is approved, the candidate shall work for a minimum of one year with the new Research Supervisor, if the topic of his/her research is different under the new supervisor, provided he/she fulfils the attendance requirements.

## **10.9 Change of Topic of Research**

10.9.1 Change of the specific area of research may be permitted within one year from the date of admission and request must be submitted with the recommendations of the RAC. In such cases, the minutes of the RAC meeting must include whether the course work

undertaken by the research scholar is relevant to the new research area and the competence of the research supervisor in this field.

10.9.2 If the RAC is of the view that there is a major change in the specific area of research and is not relevant to the course work undertaken, the research scholar will have to go through the process of fresh examination pertaining to the area of research.

10.10 Absence of Member during Qualifying / Final Viva-Voce Examination

Under extra-ordinary circumstances if the qualifying / final viva-voce examination to Ph.D. student has to be conducted in the absence of one or two RAC members, permission to conduct the examination by co-opting another member in such contingencies should be obtained from the Director, DARE in advance.

## 11. EVALUATION OF STUDENT'S PERFORMANCE

All students shall abide by the rules for evaluating the course work under the semester system of education, as prescribed from time to time by the University.

## 12. EXAMINATIONS

12.1 There will be two examinations viz., first test and final examination. Wherever the course has practical, there will be a final practical examination also.

12.2 The duration of first test will be of one and half an hour and final examinations in theory and practical will be conducted for three hours each.

12.2.1 The first test will be conducted by course teachers during the ninth week of the semester as per the scheme drawn by HOD, evaluate and send the marks obtained by the students to the Director, DARE through HOD within seven working days.

12.2.2. The question paper for the final examination will be set as per Bloom's taxonomy by the concerned course teacher in consultation with the Head of the Department.

12.2.3 There will be final examination separately for theory and practical which will be conducted by the University. Each final theory and practical examinations will be evaluated by two examiners (one will be the course teacher and another will be the senior faculty of the Department).

The distribution of marks will be as indicated below:

S. No	Examination	Course with practical	Course without practical	Course without theory
1	First Test	30	30	30
2	Final theory	40	70	-
3	Final practical	30	-	70
	<b>Total</b>	<b>100</b>	<b>100</b>	<b>100</b>

The question paper model and distribution of marks for first test and final theory examinations are as follows:

**First Test (30 marks) (1.5 hours duration)**

1	Definitions/concepts	5 out of 7	(5 x 1)	5 marks
2.	Short notes	5 out of 7	(5 x 3)	15 marks
3	Essay type	2 out of 3	(2 x 5)	10 marks

**Final Theory: Course without practical (70 marks) (3 hours duration)**

1.	Short notes	5 out of 7	(5 x 4)	20 marks
2	Essay type	5 out of 7 (four questions must represent K6 level of Bloom's taxonomy)	(5 x 10)	50 marks

**Final Theory: Course with Practical (40 marks) (3 hours duration)**

1.	Short notes	5 out of 7	(5 x 2)	10 marks
2	Essay type	5 out of 7 (four questions must represent K6 level of Bloom's taxonomy)	(5 x 6)	30 marks

**12.3 Minimum Marks for Pass**

12.3.1 The student should secure a minimum of 60 per cent marks separately in the theory and practical and an aggregate of 70 per cent to secure a pass in the subject. Each subject shall carry a maximum of 100 marks for purpose of grading. The grading will be done as grade point, i.e., the percentage of marks earned in a subject is divided by 10. The grade point is expressed on a 10 point scale upto two decimals.

12.3.2 Students who secure marks below 70 per cent in a subject will be awarded 'RA' grade and students without having the required minimum attendance of 80 per cent will not be allowed to write the final examination and they will be awarded 'E' grade. Students who secure 'RA' grade should appear for re-examination in the subsequent semester. If a student secured 'E' grade, he/she has to re-register and attend the course again during the next academic year.

**12.4 Minimum GPA Requirement**

A Ph. D. student, to continue his/her studies in the University, should maintain certain minimum Average Grade Point prescribed here under:

- a) Earn a Grade Point of 7.00 for a pass in each subject.
- b) For purpose of continuing as a student in the university, a candidate is required to earn a Grade Point Average of not less than 7.50 at the end of each semester.
- c) A Ph.D. student may repeat the course (s) in which he/she gets a Grade Point below 7.50 and above 7.0 to improve the OGPA.

**12.5 Re-Examination**

12.5.1 Re-examination is permitted only for the final theory and practical examinations. The students who secure 'RA' grade are permitted to write the re-examinations as and when conducted with the permission of university.

12.5.2 The re-examination fee as prescribed by university per course is to be paid on or before the prescribed date. A student is permitted to write the final theory and practical examinations only two times during the course period of three years excluding the regular final examination.

12.5.3 In the event of a student who fails to secure a pass in the two re-examinations permitted, he/she has to re-register for the course along with juniors. The marks secured in first test will be retained and the student should produce the practical record during re-examination. The registration for the re-examination shall be done after first test on the date specified by the Director, DARE. Each registration is considered as an attempt even if the student absents for the examination.

#### 12.6 Return of Valued Answer Papers

12.6.1 The valued answer papers of first test shall be shown to the students after the examination. Discrepancies if any, in awarding marks, the student can approach the teacher concerned immediately for rectification.

12.6.2 The answer paper should be retained with the course teacher for six months and then disposed off. Evaluated final theory papers have to be retained up to six months by the Director, DARE after the conduct of examination and then disposed off.

### 13. SEMINAR

Seminar is compulsory for all students and each student should register and present two seminars each with 0+1 credits. A student can register only one seminar in a semester and only after successful completion of the first seminar, the student is permitted to register for the second seminar.

#### 13.1 Seminar Topic

13.1.1 The seminar topic should be only from the major field and should not be related to the area of thesis research. The seminar topics are to be assigned to the students by the Research Supervisor in consultation with HOD within three weeks after commencement of the semester.

13.1.2 Under the guidance and supervision of the Research Supervisor of the RAC, the student should prepare a seminar paper containing not less than 50 typed and printed pages with a minimum number of 75 references covering the recent 10 years time after reviewing all the available literature and present the seminar after completion of 80% attendance in the semester in the presence of the HoD, RAC, staff and post-graduate students of the concerned department.

13.1.3 The circular on the presentation of the seminars may be sent to other Departments to enable those interested to attend the same. The Research Supervisor will monitor the progress of the preparation of the seminar and correct the manuscript.

13.1.4 The student will submit two copies of the corrected manuscript to the HOD through Research Supervisor before presentation. The student will incorporate the suggestions and carry out corrections made during the presentation and resubmit three fair copies to the HOD (one to Dept. library, the second to the Research Supervisor and the third for student) within 15 days after presentation.

13.1.5 The performance of the student in the credit seminar will be evaluated and grade point awarded by the HOD along with the RAC for 100 marks. Grade Point may be given based on the following norms

<b>Details</b>	<b>Marks</b>
Coverage of literature	40
Presentation	30
Use of audio-visual aids	10
Capacity to participate in discussion and answer the questions	20
<b>Total</b>	<b>100</b>

#### **14. QUALIFYING EXAMINATION**

Only those students who successfully complete the qualifying examination will be admitted to candidacy of the degree. The qualifying examination consists of only Viva-voce examination.

##### 14.1 Minimum requirement for qualifying Viva-voce Examination

The students who have completed all the courses and earned a grade point average of not less than 7.5 will be permitted to appear for the qualifying examination. Students who do not satisfy these requirements shall not be permitted to take up the qualifying examination. The qualifying examination will be conducted after the successful completion of course work.

##### 14.2 Selection of Examiner

A panel of five external examiners for qualifying examinations shall be given by the RAC in consultation with HOD before three months of the date of completion of the student's course work to the Director, DARE. One of them will be appointed as external examiner.

##### 14.3 Qualifying Viva-Voce Examination

14.3.1 The evaluation should cover both the research problem and theoretical background to execute the project. This shall assess the aptitude of the student and suitability of the student for the given research topic.

14.3.2 The RAC shall conduct the qualifying viva-voce examination with one external member, who shall be a specialist in the subject from outside the university.

14.3.3 The Head of the Department will monitor and coordinate the conduct of the qualifying viva. The performance of the candidate will be graded as Satisfactory / Unsatisfactory.

##### 14.4 Communication of Results of Qualifying Examination

The Research Supervisor shall act as chairman for the examination committee and shall be responsible for communicating the results of the examination to the Director, DARE through HOD in the prescribed format.

#### **14.5 Failure /Absence in Qualifying Examination**

14.5.1 When a student fails or absents for the qualifying examination, he/she may apply again for permission to appear for re-examination to the Director, DARE with the recommendation of the RAC and Head of the Department.

14.5.2 A student, who applies for re-examination should attend viva-voce. Re-examination shall not take place earlier than one month after the first examination. It will be conducted by the RAC as previously indicated.

14.5.3 If a student fails in the re-examination, further re-examination will be considered on the recommendation of the RAC, HoD and Dean, Faculty of Agriculture. If the student fails in the qualifying examination, he/she is not permitted to register for further research credits in the next semester.

### **15. THESIS RESEARCH**

#### **15.1 Selection of Topic**

15.1.1 The thesis research for the Ph.D. degree should be of the nature of a definite contribution to the subject and the results should be of sufficient importance to merit publication. The findings should have some practical utility or should lead to theoretical contribution.

15.1.2 The thesis shall be on a topic falling within the field of the major specialization and shall be the result of the student's own work. A certificate to this effect duly endorsed by the major advisor shall accompany the thesis

#### **15.2 Research Proposal**

15.2.1 The research scholars shall present their broad area of research and submit a proposal to the Research Advisory Committee at the end of the first semester.

15.2.2 The research proposal has to be presented by the student in a meeting organized by the Head of the Department to get the opinion / suggestion of the faculties of the Department for improving it. Three copies of the research proposal in the prescribed format should be sent to the Director (DARE) through the Head of the Department for approval.

15.2.3 The distribution of research credit will be as follows:

<b>Semester</b>	<b>Credit Hours</b>
I Semester	0+2
II Semester	0+10
III Semester	0+16
IV Semester	0+16
V Semester	0+16
VI Semester	0+15

<b>Total</b>	<b>0+75</b>
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### 15.3 Evaluation of Thesis Research

15.3.1 After assigning the research problem, for each semester, the student has to submit a detailed programme of work to be carried out by him/her during the semester in the prescribed proforma. After scrutiny and approval, a copy of the research programme has to be given to the student for carrying out the work during that semester.

15.3.2 Attendance register must be maintained in the department by HOD for all the students to monitor whether the student has 80% of attendance in research.

15.3.3 The student has to submit his/her research observation note book to the Research Supervisor, who will scrutinize the progress and sign the note book with remarks as frequently as possible. This note book will form the basis for evaluation of research progress.

15.3.4 After completion of 80% attendance for research and on or before the last day of the semester, the research scholars, shall submit Progress Reports in the prescribed format duly endorsed by the Research Advisory Committee to the Director, DARE until they submit their synopsis.

15.3.5 Failure to submit the progress reports shall entail automatic cancellation of registration.

15.3.6 The minutes of the meeting of the Research Advisory Committee along with enclosures will be sent to the Director, DARE.

15.3.7 Candidates who are recipients of fellowships such as JRF/SRF directly from any of the funding agencies/ shall send the progress reports and the utilization certificates in the format prescribed by the respective funding agency through proper channel.

15.3.8 The procedure of evaluating research credits under different situations are explained hereunder.

#### **SITUATION – I**

The student has completed the research credits as per the approved programme and awarded **SATISFACTORY** by the RAC. Under the said situation, the student can be permitted to register for fresh research credits in the subsequent semester. If the student is awarded **UNSATISFACTORY**, he/she has to re-register the same block of research credits in the subsequent semester.

#### **SITUATION – II**

The student who has not secured the minimum attendance of 80 per cent shall be awarded grade 'E'. The student has to re-register the same block of research credits for which 'E' grade was awarded earlier in the following semester with prior permission. Until the

completion of re-registered credits, the student should not be allowed to register for fresh (first time) research credits.

### **SITUATION – III**

The student could not complete the research as per the approved programme of work for reasons beyond his/her control such as,

- Failure of crop
- Non-incidence of pests or disease or lack of such necessary experimental conditions.
- Non-availability of treatment materials like planting materials chemicals, etc.
- Any other impeding / unfavorable situation for satisfying the advisory committee.
- Under the said situations, grade **EE** should be awarded.

In the mark list, it should be mentioned that E grade or EE grade was awarded due to ‘lack of attendance’ or ‘want for favourable experimental conditions’.

### **SITUATION – IV**

When the student fails to complete the work even in the ‘second time’ registration, the student will be awarded **UNSATISFACTORY** and, in the mark, list the ‘second time’ should be mentioned.

For the registration of research credits for the third time, permission has to be obtained from the Dean based on the recommendation of the RAC, and HOD.

Permission for registration for the fourth time shall be given only by the University based on the recommendation of the RAC, HOD and Dean, Faculty of Agriculture.

## **16. SUBMISSION OF THESIS**

16.1 The research credits registered in the last semester should be evaluated only at the time of the submission of thesis, by the RAC. Students can submit the thesis at the end of the final semester.

16.2 If a student has completed the thesis before the closure of the final semester, the research supervisor can convene the RAC meeting and take decision on the submission of the thesis, provided the student satisfies 80 per cent attendance requirement.

16.3 The candidate shall be allowed to submit his/her thesis after the completion of stipulated period. A grace period of 30 days may be allowed to submit the thesis after the prescribed duration. If the thesis is not submitted even after the grace period, the student shall pay the tuition fee for the ensuing year.

16.4 If a student is not able to submit the thesis within the grace period, the student has to re-register for the credits in the forthcoming semester. The student who re-registers the credits after availing of the grace period will not be permitted to avail of grace period for



the second time. The Head of the Department can sanction the grace period based on the recommendation of advisory committee and a copy of the permission letter along with the receipt for payment of fine should accompany the thesis while submission.

16.5 Three copies of the thesis (in the approved format) shall be submitted together with the submission fee not later than three months after the submission of the synopsis.

16.6 No dues certificates from the Department and Central Libraries, Hostel, Stores, etc. must be submitted with the thesis copies. The Research Supervisor shall forward the thesis copies with the enclosures to the Director, DARE through the HOD and the Dean. A soft copy of the thesis in PDF format as prescribed by Shodhganga, shall also be submitted.

16.7 The Ph.D. scholars have to publish a minimum of two research papers in NAAS rated journals with 5 and above rating/ Scopus / Web of Science indexed journals at the time of publication of the papers. The synopsis will be accepted for processing only after showing evidences for publications of two such research papers.

16.8 The soft copy of the thesis shall be checked for plagiarism using Turnitin software. Beyond the percentage of reproduction prescribed by UGC, the thesis will not be accepted for valuation.

#### **16.9 Pre-submission Presentation**

16.9.1 The pre-submission presentation of the thesis is a requirement to enrich the scholar and to fine tune his/her research presentation. This presentation shall be conducted before the submission of the synopsis in the presence of the RAC, Supervisor/Co-Supervisor, HoD, Faculty members, Research Scholars and/or P.G. Students.

16.9.2 The scholar shall present the findings. The gathering may suggest ideas / references to be consulted / suggestions to improve the work.

16.9.3 A report on this event along with an attendance sheet shall be forwarded by the Research Supervisor with the endorsement of the RAC and HOD to the Director, DARE.

#### **16.10 Submission of Synopsis**

16.10.1 The submission of synopsis may be permitted 3 months before the completion of required duration on successful completion of course work.

16.10.2 The Research Scholar shall submit 3 copies of the synopsis approved by the Research Advisory Committee along with a soft copy to the Director, DARE through the Research Supervisor, the HOD and Dean of the respective Faculty.

16.10.3 Guidelines for the preparation of the synopsis are appended in Appendix I. Name of the candidate and name of the supervisor shall not be mentioned anywhere in the synopsis; enrolment number of the candidate alone shall be given. A model cover page for a synopsis is given in Appendix III.

#### **16.11 Guidelines for Preparation of Thesis**

16.11.1 The thesis shall not exceed 250 pages excluding the Bibliography, Appendices, etc. If it exceeds the specified number of pages, the Research Supervisor should write to university with the reasons and get prior approval from the University. The candidate shall

pay a penalty for the excess number of pages as decided by the Deans Committee. The thesis should be in A4 size.

16.11.2 The specification for the preparation of the thesis is given in Appendix II. A model cover page for a thesis is given in Appendix IV.

16.11.3 The thesis shall be typed on both sides of the page in order to save paper and postage. The thesis shall contain a Certificate from the guide (Annexure) specifying that the thesis submitted is a record of research work done by the candidate during the period of study under him/her and that the thesis has not previously formed the basis for the award of any Degree, Diploma, Associateship, Fellowship or similar title.

16.11.4 A statement from the guide indicating the extent to which the thesis represents independent work on the part of the candidate should also be made. (Appendix V)

## **16. VALUATION OF THE THESIS**

### **17.1 Panel of Examiners**

17.1.1 The thesis submitted in partial fulfilment of the Ph.D. degree shall be evaluated by two external experts one from within the country and the other from outside the country appointed by the Vice-Chancellor on the recommendation of the Research Supervisor of the RAC, HOD and Dean.

17.1.2 The external experts shall be chosen from a panel of at least five names of specialists separately from within the country and outside the country in the particular field, suggested by the Research Supervisor.

17.1.3 The external experts shall send their evaluation reports on the thesis directly to the Director, DARE along with the copy of the evaluated thesis. The Director, DARE on receipt of the reports from the two examiners will send them to the concerned Research Supervisor who is the convener of viva-voce board.

17.1.4 The Research Supervisor will send the consolidated report with his remarks to the Director, DARE through the Head of the Department. Based on the satisfactory reports of the evaluation, Viva-voce examination will be arranged.

17.1.5 After a student's thesis for Ph.D. degree is evaluated as indicated above, the thesis shall be finally accepted for the award only after the student satisfactorily completes the final Viva-voce examination.

17.1.6 The Viva-Voce board comprises the student's RAC with the addition of the external examiner who valued the thesis, and the HOD. If the HOD happens to be the Research Supervisor, the Dean, Faculty of Agriculture will nominate a senior member of the staff of the concerned Department as a member.

17.1.7 The candidate is expected to defend the thesis at the Viva-voce examination. The degree shall be awarded on the unanimous recommendation of the Viva-Voce board as **satisfactory** with regard to the thesis and the performance of the student in the final Viva-voce examination.

17.1.8 The recommendation of the Viva-Voce board shall be forwarded to the Director, DARE by the Research Supervisor through HOD and Dean which shall be signed by all members of the committee and the external examiner.

17.1.9 A candidate who is not successful (unsatisfactory) at the Viva-voce examination will be permitted to undergo the Viva-voce examination again within a period of three months

### **17.2 Revision and Resubmission of Thesis**

17.2.1 If an examiner recommends change / further work, the thesis will be referred to the same examiner after compliance for his/her opinion. In case of rejection by any one of the examiners, the thesis will be sent to another examiner and his / her recommendation will be final.

17.2.2 If the thesis is recommended to be revised by one or both examiners, the points of revision will be indicated clearly in the report. The necessary correction should be carried out, and the revised version should be sent to the concerned examiner(s). If the examiner(s) is / are still not satisfied with the revised version, the thesis will be rejected. If the thesis is accepted by the examiners (Evaluation), Viva-Voce examination will be conducted by the viva-voce board.

### **17.3 Re-registration and Submission of Thesis**

The minimum of 80% attendance requirement for submitting the thesis after re-registration need not be insisted for those students who have fulfilled the minimum academic and residential requirement of three years.

### **17.4 Extension of Time**

17.4.1 Research scholars who do not submit the thesis within the stipulated period should apply for extension of time three months before the completion of three years. Extension of time and the fees to be paid will be considered by the Deans Committee, if the extension is duly recommended by the RAC, Head of the Department, and the Dean of the Faculty, such candidates will be eligible for extension of time for a maximum period of three years.

17.4.2 The scholar will have to enrol as fresh candidates if he/she fails to submit the thesis within the maximum extension period of three years when granted.

17.4.3 If a scholar requires a few more months after the expiry of the maximum extension period of three years for the submission of the thesis as per the evaluation of the RAC, duly recommended by the Head of the Department and the Dean of the Faculty, as an exceptional case, the Deans committee may consider for re-registration to enable the scholar to submit the thesis. In any case, the time granted shall not exceed six / twelve months.

### **17.5.1 Number of Chances**

17.5.1 A candidate will not be permitted to submit a thesis for the degree on more than two occasions. However, it will be open to the Syndicate, if the Board of Examiners so recommend, to permit the candidate to submit a thesis on a third occasion.

17.5.2 Also, he / she will not be permitted to appear for the viva-voce examination on more than two occasions.

## **18. DISCONTINUANCE AND READMISSION**

18.1 Students admitted to the Ph.D. degree who discontinue their studies before completing the degree with written permission from the university may be re-admitted to the degree programme, provided that the student should have completed the course work before such discontinuance. However, the period of such discontinuance should not exceed five years for Ph.D. Degree from date of admission.

18.2 After completion of course work and qualifying examination, a student is eligible to discontinue temporarily his research program only once within 5 years for Ph. D. program. If the discontinuation period exceeds two semesters, the student has to forego the research credits already registered and register afresh with revised program.

18.3 In the case of field experiments or laboratory experiments in which continuity is essential for research and if a student temporarily discontinues in the middle without completing the experiments, then the entire experiment should be repeated, even if the discontinuation period does not exceed two semesters.

18.4 A student joining the studies, after discontinuation should pay the fees of the existing semester.

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### Semester wise Distribution of Credit

Semester	Major Course	Minor Course	Supporting Course	Seminar	Research
I	6	4	2	1	2
II	6	2	3	1	10
III	-	-	-	-	15
IV	-	-	-	-	16
V	-	-	-	-	16
VI	-	-	-	-	16
<b>Total credit</b>	<b>12</b>	<b>6</b>	<b>5</b>	<b>2</b>	<b>75</b>

### Distribution of Courses

Course code	Course Title	Credit hour (Theory + Practical)
<b>Major Courses</b>		<b>12</b>
PSM 601*	Advances in Production of Plantation and Spice Crops	3+0
PSM 602*	Advances in Production of Medicinal and Aromatic Crops	3+0
PSM 603*	Recent Breeding Approaches in Plantation, Spice, Medicinal and Aromatic Crops	3+0
PSM 604	Advanced Methods in Laboratory Techniques for PSMA crops	1+2
PSM 605	Biotechnological Approaches in PSMA Crops	3+0
<b>Minor Course</b>		<b>6</b>
PSM 606	Abiotic Stress Management in Plantation, Spice, Medicinal and Aromatic Crops	2+1
PSM 607	Organic Spice and Plantation Crops Production	2+1
PSM 608	Marketing and Export of Plantation, Spice, Medicinal and Aromatic Crops	2+1
<b>Supporting Courses</b>		<b>5</b>
COM 601	Advances in Computer Applications (1+1)	2
STA 601	Advances in Designs of Experiments (2+1)	3
<b>Seminar</b>		
	Doctoral Seminar - I (0+1)	1
	Doctoral Seminar - II (0+1)	1
<b>Research</b>		
	Doctoral Research (0+75)	75
<b>Non credit compulsory courses</b>		

	MOOC (2+0)	-
	Research and Public Ethics (2+0)	-

### Semester wise Distribution of Courses

Sl. No	Courses	Credit Hours
<b>I</b>	<b>First Semester</b>	
1	Major Courses	6
2	Minor courses	3
3	COM 601 Advances in Computer Application	1+1
4	PSM 691 Seminar	0+1
5	PSM 699 Research	0+2
	<b>Total credits</b>	<b>0+14</b>
<b>II</b>	<b>Second Semester</b>	
1	Major Courses	6
2	Minor courses	3
3	STA 601 Advances in Designs of Experiments	2+1
4	PSM 692 Seminar	0+1
5	PSM 699 Research	0+10
	<b>Total credits</b>	<b>0+23</b>
<b>III</b>	<b>Third Semester</b>	
1	Research and Public Ethics*	2+0
2	PSM 699 Research	<b>0+15</b>
<b>IV</b>	<b>Fourth Semester</b>	
1	MOOC*	2+0
2	PSM 699 Research	<b>0+16</b>
<b>V</b>	<b>Fifth Semester</b>	
1	PSM 699 Research	<b>0+16</b>
<b>VI</b>	<b>Sixth Semester</b>	
1	PSM 699 Research	<b>0+16</b>
	<b>Grand total</b>	<b>100</b>

\*Non credit compulsory course.

## **DEPARTMENT OF HORTICULTURE**

### **Ph.D. HORTICULTURE in Plantation, Spices, Medicinal and Aromatic Crops**

#### **PROGRAMME OUTCOME**

**PO 1** - The scholar will acquire knowledge on crop improvement, production technologies, biotechnology and postharvest technologies pertaining to PSMA crops with special reference to advancement in research.

**PO 2** - The scholar will gain skills in approaching research problems and define research methodology for problems solving research in the field of PSMA crops.

**PO 3** - The scholar will be able to do individual research works in PSMA crops.

**PO 4** - The scholar will become eligible to work in research programmes offered by national and international organizations and in teaching PSMA.

**PO 5** - The scholar will be able to develop expertise in scientific writing and publication of a research outcome.

## PSM – 601 ADVANCES IN PRODUCTION OF PLANTATION AND SPICE CROPS (3+0)

### Learning objectives

- The course is designed to provide advanced crop production techniques of various plantation and spice crops grown in India.
- The course is designed to provide advanced crop production techniques of various spice crops grown in India.
- This course will impart knowledge to the learner on advanced scientific production technology of various plantation in Indian perspectives.
- This course will impart knowledge to the learner on advanced scientific production technology of various spice crops in Indian perspectives.
- To discuss Hi-tech production technologies in plantation and spice crops.

### Theory

#### Unit-I: Importance of Plantation and Spice Crops

Area, production, productivity: Indian and world scenario: Role of plantation and spice crops in national economy, area-production statistics at national and international level, productivity challenges, industrial requirement of plantation and spice crops, demand-supply scenario of plantation and spice crop. Export potential: Export scenario, market opportunities and challenges in plantation and spice crops, global imports and exports, export of organic produce and products.

#### Unit-II: Role of commodity boards and directorates

Promotional programmes: Role of commodity boards and directorates in the development programmes of plantation and spice crops, contract farming, Farmer Producer Organizations (FPO) and Farmer Producer Companies (FPC).

#### Unit-III: Varietal wealth and planting material production

Cultivars and improved varieties in plantation and spice crops, mass multiplication techniques, hi-tech nursery techniques. Agro techniques: Precision farming techniques, HDP systems, fertigation, chemical regulation of crop productivity, protected cultivation of high value crops, mechanization in plantation and spice crops, hydroponics, aeroponics, application of nanotechnology, robotics

#### Unit-IV: Impact of climate change

Impact of biotic and abiotic factors on growth and productivity, climate resilient technologies in plantation and spice crops, soil health management, organic production systems.

#### Unit-V: Harvest and Post harvest management

Influence of pre and post-harvest factors on quality of plantation and spice crops, pre and post-harvest management techniques for improving quality, good manufacturing practices in plantation and spice sector. Quality standards: Domestic and international standards, HACCP, BIS standards, domestic and export grades, modern packaging techniques, export protocols.

### Lesson plan

1. Area, production, productivity, Indian and world scenario, Role of plantation crops in national economy
2. Area, production, productivity, Indian and world scenario, Role of spice crops in national economy
3. Productivity challenges, industrial requirement of plantation and spice crops.



4. Demand-supply scenario of plantation and spice crops.
5. Export and import scenario, market opportunities and challenges in plantation crops.
6. Export and import scenario, market opportunities and challenges in Spices crops.
7. Export of organic produce and products in plantation and spice crops.
8. Role of commodity boards and directorates in the development programmes of plantation crops.
9. Role of commodity boards and directorates in the development programmes of spices crops.
10. Contract farming in spices and plantation crops.
11. Farmer Producer Organizations (FPO) and Farmer Producer Companies (FPC) related to plantation and spice crops
12. Cultivars, improved varieties, mass multiplication techniques and hi-tech nursery techniques - Precision farming techniques- Cropping systems, multi-tier, companion cropping system, HDP systems, shade management, irrigation- Nutrient management, fertigation, soil and moisture conservation practices, training and pruning, mulching and weed management mechanization & Robotics in harvesting, drying, packaging, processing and value addition, for the following crops.
- 13-14. Coconut
15. Areca nut
16. Oil Palm
- 17-18. Cashew
- 19-20. Coffee
- 21-22. Tea
- 23. Rubber**
24. Cocoa
25. **First Test**
26. Palmyra- Varieties, soil and climate, propagation techniques and nursery management, planting systems, shade and basin management- INM practices, irrigation, chemical regulation, pest and disease management, harvest, Post-harvest and value addition
- 27- 28. Black pepper
- 29-30. Cardamom
31. Ginger
32. Turmeric
33. Nutmeg
34. Cinnamon
35. Clove
36. Other tree spices
37. Vanilla
38. Garcinia
39. Coriander
40. Fenugreek
41. Fennel
42. Cumin
43. Ajwaon
44. Dill
45. Saffron
46. Impact of biotic and abiotic factors on growth and productivity in plantation and spice crop.
47. Climate resilient technologies and soil health management, for plantation and spices crop.

48. Quality standards - Domestic and international standards, HACCP, BIS standards, domestic and export grades, modern packaging techniques, export protocols
49. Organic cultivation practices for plantation crops
50. Organic cultivation practices for spice crops
51. Application of nanotechnology in spices and plantation Crops

### **COURSE OUTCOME**

After successful completion of this course, the scholars

**CO 1** are expected to be equipped with the latest research outcome in commercial cultivation of plantation crops

**CO 2** are expected to be equipped with the latest research outcome in commercial cultivation of plantation crops

**CO 3** able to start commercial cultivation of plantation crops

**CO 4** able to start commercial cultivation of spice crops

**CO 5** able to start hi-tech plantation and spice crop based enterprises

**CO - PO Mapping matrix**

	<b>PO 1</b>	<b>PO 2</b>	<b>PO 3</b>	<b>PO 4</b>	<b>PO 5</b>
<b>CO 1</b>	<b>2</b>	<b>3</b>	<b>3</b>	<b>2</b>	<b>2</b>
<b>CO 2</b>	<b>2</b>	<b>3</b>	<b>3</b>	<b>2</b>	<b>3</b>
<b>CO 3</b>	<b>3</b>	<b>1</b>	-	-	-
<b>CO 4</b>	<b>3</b>	<b>1</b>	-	-	-
<b>CO 5</b>	<b>3</b>	<b>1</b>	-	-	-

### **References**

1. Barche, S. 2016. Production Technology of Spices, Aromatic, Medicinal and Plantation Crops. New India Publishing Agency, New Delhi.
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4. Choudappa, P., Niral, V., Jerard, B.A., and Samsudeen, K. 2017. Coconut. Daya Publishing House, New Delhi.
5. E-manual on Advances in Cashew Production Technology. ICAR-Directorate of Cashew Research, Puttur -574 202, D.K., Karnataka.
6. Joshi, P. 2018. Text Book on Fruit and Plantation Crops. Narendra Publishing House, New Delhi.
7. Ravindran, P.N. 2017. The Encyclopedia of Herbs and Spices. CABI
8. Sharangi, A. B. and Datta, S. 2015. Value Addition of Horticultural crops: Recent trends and Future directions. SPRINGER; ISBN: 978-81-322-2261-3.
9. Sharangi, A.B. 2018. Indian Spices: The legacy, production and processing of India's treasured export. Springer International publishing. AG, Part of Springer Nature, 2018, Cham, Switzerland.
10. Swain, S.C. 2018. Precision Farming in Horticulture: Approaches and strategies. Narendra Publishing House, New Delhi.

### **E - Resources**

1. <file:///C:/Users/admin/Downloads/RecentAdvancesinProductionTechnologyofTreeSpices.pdf>
2. <https://academic.oup.com/fqs/article/3/2/73/5513353>
3. <http://www.fnbnews.com/FB-Specials/technological-innovations-in-spices--methodology-types43143>
4. <http://www.jnkvv.org/PDF/05042020135315spices.pdf>
5. <http://www.spices.res.in/events/advances-production-technology-turmeric>
6. <http://cpcri.nic.in/>
7. <http://indiacofee.org/>
8. <http://kar.nic.in/cashew/>
9. <http://www.ap.nic.in/ncrop>
10. <http://rubberboard.org.in/>
11. <http://tea.nic.in/>
12. <http://cpcri.nic.in/>

**PSM - 602 ADVANCES IN PRODUCTION OF MEDICINAL AND AROMATIC CROPS  
(3+0)**

**Learning objectives**

- This course will impart knowledge to the learner on advanced scientific production technology of various medicinal crops in Indian perspectives.
- This course will impart knowledge to the learner on advanced scientific production technology of various aromatic crops in Indian perspectives.
- To impart comprehensive knowledge on medicinal plants and to keep abreast with latest developments and trends in production technology of medicinal crops.
- To impart comprehensive knowledge on aromatic plants and to keep abreast with latest developments and trends in production technology of aromatic crops
- To gain the knowledge about advance cultivation of medicinal and aromatic plants

**Theory**

**Unit- I: Genetic bio-diversity of medicinal plants**

Genetic bio-diversity of medicinal plants - conservation networks - Global initiatives on medicinal plants - conservation and development - Export and import status - advanced research in bio-medicines, Nutraceuticals and natural drugs - Role of institutions and NGO's in production - GAP in medicinal crop production.

**Unit -II: Introduction**

Indian traditional wisdom and heritage - Indian herbal wealth, Documentations, databases, scientific validation - production problems of medicinal and aromatic plants - classification of medicinal crops - systems of cultivation - organic production.

**Unit -III: Production technology of medicinal plants I**

Production technologies with reference to crop improvement, climate, soil and substrate culture - improved varieties - organic production - nutrition and irrigation requirements - interculture - mulching - weed control - maturity indices - harvesting and economics of cultivation of the following crops. Senna, Periwinkle, Coleus, Ashwagandha, Glory lily, *Dioscroea sp.*, Aloe vera.

#### **Unit -IV: Production technology of medicinal plants II**

Production technologies with reference to crop improvement, climate, soil and substrate culture - improved varieties - organic production - nutrition and irrigation requirements - inter-culture - mulching - weed control - maturity indices - harvesting and economics of cultivation of the following crops - sarpagandha, Medicinal solanum, Isabgol, Safed Musli, Stevia, Gymnema.

#### **Unit -V: Production technology of Aromatic plants**

Aromatic industry - Export and import status - Advancement and production technology for Palmarosa, Lemongrass, Citronella, Vettiver, Geranium, Mentha, Ocimum, Eucalyptus, Rosemary, Thyme, Patchouli, Lavender, Marjoram, Oreganum.

#### **Lesson plan**

1. Genetic bio-diversity of medicinal plants
2. Conservation networks of medicinal plants
3. Global initiatives on conservation and development of medicinal plants
4. Export and import status of medicinal crops
5. Advanced research in bio-medicines and nutraceuticals
6. Role of institutions and NGO's in production of medicinal plants
7. GAP in medicinal crop production
8. Indian herbal wealth
9. Indian traditional wisdom and heritage
10. Documentation and scientific validation
11. Production problems of medicinal plants
12. Production problems of aromatic plants
13. Classification of medicinal plants and systems of cultivation
14. Organic production of medicinal plants.
15. History, importance, present status, crop improvement, varieties, propagation and production technology of the following crops.
16. Senna
17. Perwinkle
18. Coleus
19. Ashwagandha
20. Glory lily
21. Sarpagandha
22. Aloe vera
23. Medicinal Solanum
24. Isabgol
- 25. First Test**
26. Safed Musli
27. Stevia
28. Gymnema
29. Dioscorea
30. Digitalis sp
31. Commiphora sp, Centella
32. Ipecae and Henbane
33. Ocimum sp
34. Bacopa, Saraca

35. Valerian, Jatamansi
36. Aconits, Ephedra
37. Bael
38. Post harvest handling of medicinal crops
39. Extraction of secondary metabolites from medicinal crops
40. Lemongrass
41. Citronella
42. Vettiver
43. Geranium
44. Mentha
45. Palmarosa
46. Rosemary
47. Thyme
48. Eucalyptus
49. Patchouli, Lavender
50. Marjoram, Oreganum
51. Post harvest handling of aromatic crops
52. Extraction of essential oil from aromatic crops

### **COURSE OUTCOME**

After successful completion of this course, the students are expected to:

**CO 1** Be equipped with the latest research out come in commercial cultivation of medicinal crops

**CO 2** Be equipped with the latest research out come in commercial cultivation of aromatic crops

**CO 3** Be able to start hi-tech medicinal and aromatic crop based enterprises

**CO 4** Be able to start hi-tech aromatic crop based enterprises

**CO 5** the learner empowered to start commercial cultivation of medicinal and aromatic crops

### **CO - PO Mapping matrix**

	<b>PO 1</b>	<b>PO 2</b>	<b>PO 3</b>	<b>PO 4</b>	<b>PO 5</b>
<b>CO 1</b>	2	2	3	3	2
<b>CO 2</b>	2	2	3	3	2
<b>CO 3</b>	1	1	3	2	1
<b>CO 4</b>	1	1	3	2	1
<b>CO 5</b>	-	-	1	1	-

### **Refernces**

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8. Swain, S.C. 2018. Precision farming in Horticulture: Approaches and strategies. Narendra Publishing House, New Delhi.
9. Tiwari Chandra, 2018. Antimicrobial properties of Medicinal plants. Narendra Publishing House, New Delhi.

#### **E - Resource**

1. <http://www.cimap.org/>
2. <http://www.fintrac.com/gain/>
3. <http://www.iari.res.in/>
4. <http://dsir.nic.in/>

### **PSM - 603 RECENT BREEDING APPROACHES IN PLANTATION, SPICE, MEDICINAL AND AROMATIC CROPS (3+0)**

#### **Learning objectives**

- This course will impart knowledge to the learner on the advanced breeding approaches followed in important PSMA crops in Indian perspectives.
- The course is designed to provide knowledge on modern approaches in the breeding of various PSMA crops grown in India.
- To identify the methods that contributes towards greater efficacy in the selection processes and in the development of new varieties.
- This course also helps to design a breeding programme for a given crop species for the conditions of the need according to specific objectives.

#### **Theory**

Evolutionary mechanisms, adaptation and domestication, genetic resources, genetic divergence, cytogenetics, variations and natural selection, types of pollination and fertilization mechanisms, sterility and incompatibility systems - Introduction and selection, chimeras, clonal selections, intergeneric, interspecific and inter-varietal hybridization, heterosis breeding, mutation and polyploidy breeding. Resistance breeding to biotic and abiotic stresses, breeding for improving quality, genetics of important traits and their inheritance pattern, molecular and transgenic approaches and other biotechnological tools in crop improvement - Breeding objectives, ideotype breeding, breeding problems and achievements in Plantation crops, medicinal and aromatic crops-

#### **Unit I: Breeding of plantation crops I**

Coconut, Areca nut , Oil palm , Cashew

#### **Unit II: Breeding of plantation crops II**

Coffee, Tea, Cocoa, Rubber

#### **Unit III: Breeding of spice crops**

Black pepper, Cardamom, Ginger, Turmeric, Nutmeg, Cinnamon, Clove and Garcinia, Coriander and Fenugreek, Fennel, cumin, Ajwain and Dill

#### **Unit IV: Breeding of medicinal crops**

Senna and Periwinkle, Ashwagandha, Medicinal coleus, Glory lily, Isabgol, Sarpagandha, Poppy, Andrographis, Aloe vera, Phyllanthus, Mucuna, Centella and Bacopa

#### **Unit V: Breeding of aromatic crops**

Lemongrass, Palmarosa, Citronella, Vetiver, Mint, Sweet basil, Lavender, Geranium, Patchouli, Artemisia, Rosemary, Thyme, Sage, Marjoram, Feverfew

### **Lesson plan**

Evolutionary mechanism, adaptation and domestication, genetic resources, genetic divergence, cytogenetics, variations and natural selection, types of pollination and fertilization mechanisms, sterility and incompatibility system, recent advances in crop improvement efforts - Introduction and selection, clonal selections, intergeneric, interspecific and intervarietal hybridization, heterosis breeding, mutation and ploidy breeding, resistance breeding to biotic and abiotic stresses, breeding for improving quality, genetics of important traits and their inheritance pattern, molecular and transgenic approaches and other biotechnological tools for the following Plantation and Spices crops

1-2. Coconut

3-4. Arecanut

5. Oil palm

6-7. Cashew

8. Coffee

9. Tea

10-11. Cocoa

12-13. Rubber

14-15. Black pepper

16-17. Cardamom

18-19. Ginger

20-21. Turmeric

22. Nutmeg and Cinnamon

23-24. Clove and Garcinia

### **25. First Test**

26. Coriander and Fenugreek

27-28. Fennel and cumin

29-30. Ajwain and Dill

Origin and evolution of varieties, distribution- Genetic resources, genetic divergence, floral biology, pollination and fertilization mechanism, specific breeding objectives, Genetic mechanisms associated with alkaloids and secondary metabolites, Methods of breeding suited to seed and vegetative propagated crops, Polyploidy and mutation breeding in the evolution of new varieties, Exploitation of heterosis, breeding achievements for improving yield and quality, biotic and abiotic stresses, breeding problems, Biotechnological approaches for crop improvement for the following Medicinal and Aromatic Crops

31-32. Senna and Periwinkle

33. Ashwagandha and Medicinal coleus

34. Glory lily and Isabgol,

35. Sarpagandha and Poppy

36. Andrographis and Aloe vera

37. Phyllanthus and Mucuna

38. Centella and Bacopa

39. Lemongrass and Palmarosa

40. Citronella and Vetiver

41. Mint and Sweet basil

- 42-43. Lavender and Geranium
44. Patchouli, Artemisia
45. Rosemary, Thyme
46. Sage, Marjoram,
47. Eucalyptus and Bael
- 48-49. Henbane and Ocimum.
50. Feverfew
51. GAP in Medicinal plants

### COURSE OUTCOME

**CO 1-** After successful completion of this course, the students are expected to be equipped with the latest research outcome in crop improvement of plantation and spice crops

**CO 2-** The students are expected to be equipped with the latest research outcome in crop improvement of medicinal and aromatic crops

**CO 3-** Be able to start hi-tech plantation crop based seed/planting material production programme

**CO 4-** Be able to start hi-tech spice crop based seed/planting material production programme

**CO 5-** Be able to start hi-tech medicinal and aromatic crop based seed/planting material production programme.

### CO - PO Mapping matrix

	PO 1	PO 2	PO 3	PO 4	PO 5
<b>CO 1</b>	3	2	2	2	2
<b>CO 2</b>	3	2	2	2	2
<b>CO 3</b>	2	1	-	-	-
<b>CO 4</b>	2	1	-	-	-
<b>CO 5</b>	2	1	-	-	-

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2. Chadha, K.L. 2001. Hand Book of Horticulture. ICAR.
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6. Peter, K.V. 2001. Hand Book of Herbs and Spices. Vols. I-III. Woodhead Publ. Co., UK and CRC, USA
7. Pradeepkumar, T., Suma, B., Jyothibhaskar and Satheesan, K.N. 2007. Management of Horticultural Crops. Parts I, II. New India Publ. Agency
8. Prajapati, N.D., Purohit, S.S, Sharma, A.K., and Kumar, T. 2006. A Hand book of Medicinal Plants. Agro Bios
9. Ravindran, P.N. 2017. The Encyclopedia of Herbs and Spices. CABI.
10. Shanmugavelu, K.G., Kumar, N. and Peter, K.V. 2002. Production Technology of Spices and Plantation Crops. Agrobios

### E - Resource

1. <https://www.ijraf.org/papers/v6-i12/3.pdf>



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3. [https://inis.iaea.org/search/search.aspx?orig\\_q=RN:40010219](https://inis.iaea.org/search/search.aspx?orig_q=RN:40010219)
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## **PSM - 604 ADVANCED METHODS IN LABORATORY TECHNIQUES FOR PSMA CROPS (1+2)**

### **Learning objectives**

- This course is designed to make the learner well versed with modern analytical methods used in quality analyses.
- This course is designed to make the learner well versed with instruments and machinery used in quality analyses.
- The main objective of the course is to equip the students with the latest laboratory techniques required for assessing the quality of plantation and spice crops.
- The main objective of the course is to equip the students with the latest laboratory techniques required for assessing the quality of medicinal and aromatic crops.
- The students will gain knowledge on commercial exploitation of spices, plantation, medicinal and aromatic crops.

### **Theory**

#### **Unit I: Physiological and biochemical changes in plantation and spice crops**

Physiological and biochemical changes: Physiological and biochemical changes during maturity and ripening including post-harvest changes. Factors influencing quality.

#### **Unit II: Contaminants and sources of contamination in plantation and spice crops**

Contaminants: Adulterants, substitutes, sources of contamination: microbial, heavy metal, pesticide residues.

#### **Unit III: Physiological and biochemical changes in medicinal and aromatic crops**

Physiological and biochemical changes: Physiological and biochemical changes during maturity and ripening including post-harvest changes. Factors influencing quality.

#### **Unit IV: Contaminants and sources of contamination in medicinal and aromatic crops**

Contaminants: Adulterants, substitutes, sources of contamination: microbial, heavy metal, pesticide residues.

#### **Unit V: Value addition of PSMA crops**

Value addition: Fixed oils, essential oils, oleoresins, concretes, absolutes, dyes, natural colours, aroma chemicals, grading, storage, transportation. Quality standards of raw materials and finished products.

### **Practicals**

Sampling techniques in PSMA crops or their parts; Solvent extraction of spices and medicinal plants; Detection of adulterants and substitutes; Extraction of secondary metabolites from medicinal crops; Qualitative analyses of secondary metabolites; Quantitative estimation of secondary metabolites; Preparation of plant extracts; Chromatographic separation of extracts; Thin layer chromatography; Soxhlet extraction; Super critical fluid extraction; Determination of physical and chemical properties of essential oils; Flavor profile of essential oils by gas chromatography; Chemical characterization by HPTLC; Chemical characterization by GCMS;

Chemical characterization by LCMS; Chemical characterization by NMR; Bioassay and High Throughput Screening; Techniques for assessment of antimicrobial property; Techniques for assessment of antioxidant property, pesticide residue analyses; Determination of heavy metals by flame photometry; Plant tissue cultures in the industrial production of bioactive plant metabolites; Exposure visit to leading medicinal and aromatic industries, accredited quality control labs.

### **Lesson plan**

1. Physiological and biochemical changes during maturity and ripening including post-harvest changes in plantation crops.
2. Factors influencing quality of plantation crops.
3. Types of contaminants in plantation crops and Sources of contamination
4. Physiological and biochemical changes during maturity and ripening including post-harvest changes in spice crops.
5. Factors influencing quality of spice crops.
6. Types of contaminants in spices and Sources of contamination
7. Physiological and biochemical changes during maturity and ripening including post-harvest changes in medicinal and aromatic crops.
8. Secondary metabolites and their biosynthetic pathways

### **9. First Test**

10. Factors affecting production of secondary metabolites.
11. Factors influencing quality of medicinal and aromatic crops.
12. Types of contaminants in medicinal and aromatic crops and Sources of contamination.
13. Value addition of plantation and spice crops: Fixed oils, essential oils, oleoresins, concretes, absolutes, dyes, natural colours, aroma chemicals.
14. Grading, storage and transportation of plantation and spice crops.
15. Value addition of medicinal and aromatic crops: Fixed oils, essential oils, oleoresins, concretes, absolutes, dyes, natural colours, aroma chemicals.
16. Grading, storage and transportation of medicinal and aromatic crops.
17. Quality standards of raw materials and finished products.

### **Practical schedule**

- 1-4 Sampling techniques in PSMA crops or their parts
- 5-6 Solvent extraction of spices and medicinal plants
- 7 Detection of adulterants and substitutes
- 8-10 Extraction of secondary metabolites from medicinal crops
- 11 Qualitative analyses of secondary metabolites
- 12 Quantitative estimation of secondary metabolites
- 13-15 Preparation of plant extracts
- 16 Chromatographic separation of extracts
- 17 Thin layer chromatography
- 18 Soxhlet extraction
- 19 Super critical fluid extraction
- 20 Determination of physical and chemical properties of essential oils
- 21 Flavor profile of essential oils by gas chromatography
- 22 Chemical characterization by HPTLC
- 23 Chemical characterization by GCMS
- 24 Chemical characterization by LCMS
- 25 Chemical characterization by NMR

- 26 Bioassay and High Throughput Screening
- 27 Techniques for assessment of antimicrobial property
- 28 Techniques for assessment of antioxidant property
- 29 pesticide residue analyses
- 30 Determination of heavy metals by flame photometry
- 31 Plant tissue cultures in the industrial production of bioactive plant metabolites
- 32 -34 Exposure visit to leading medicinal and aromatic industries and accredited quality control labs.

### **COURSE OUTCOME**

**CO 1** Have core knowledge leading to laboratory techniques and agriculture research system

**CO 2** To learn the various concept and terminologies for laboratory techniques.

**CO 3** Graduates will be acquiring knowledge about various laboratory techniques of national and international level.

**CO 4** Graduates will gains accurate and relevant analytical skill of different analytical skills and will have capacity interrupt information

**CO 5** Graduates will be able to develop a analytical skill like methods of soil and plant analysis

### **CO - PO Mapping matrix**

	<b>PO 1</b>	<b>PO 2</b>	<b>PO 3</b>	<b>PO 4</b>	<b>PO 5</b>
<b>CO 1</b>	1	3	2	2	1
<b>CO 2</b>	1	2	2	2	1
<b>CO 3</b>	2	2	1	3	1
<b>CO 4</b>	2	2	1	2	1
<b>CO 5</b>	2	2	1	2	1

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2. Das K. 2013. Essential oils and their applications. New India Publishing Agency, New Delhi.
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### **E - Resource**

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2. Analytical chemistry Dr.michaelzehfus[www.freebookcentre.net](http://www.freebookcentre.net).
3. Introduction to Instrumental Analytical Chemistry Roger Terril [www.freebookcentre.net](http://www.freebookcentre.net).
4. Analytical Chemistry lecture notes sadhu malyadri[www.freebookcentre.net](http://www.freebookcentre.net).
5. Short introduction into analytical chemistry Dr.manfredsietz and Dr.Andreassonnenberg [www.freebookcentre.net](http://www.freebookcentre.net).

## PSM - 605 BIOTECHNOLOGICAL APPROACHES IN PSMA CROPS (3+0)

### Learning objectives

- To provide an insight into the basic principles of biotechnology
- This course is designed to impart knowledge on advanced biotechnological tools used in various spheres of plantation and spice crops.
- This course is designed to impart knowledge on advanced biotechnological tools used in various spheres of medicinal and aromatic crops.
- To impart knowledge on genetic engineering techniques
- To gain information regarding the molecular markers and their thrust in Horticultural biotechnology and to thrust in Horticultural biotechnology

### Theory

#### Unit -I: Biotechnological approaches in plantation crops I

*In vitro* mass multiplication techniques: *In vitro* conservation of plantation crops, direct and indirect organogenesis, micro grafting, hardening techniques. *In vitro* breeding: Production of haploids, somaclones and identification of somaclonal variants, *in vitro* techniques to overcome fertilization barriers, protoplast culture and fusion, construction, identification and characterization of somatic hybrids and cybrids, wide hybridization, embryo rescue of recalcitrant species.

#### Unit -II: Biotechnological approaches in plantation crops II

*In vitro* mutation for biotic and abiotic stresses, disease elimination in crops. Transgenic crops: Recombinant DNA methodology, gene transfer methods, tools, methods, applications of rDNA technology. Role of molecular markers in characterization of transgenic crops, finger printing of cultivars etc., achievements, problems and future thrusts

#### Unit -III: Biotechnological approaches in spice crops I

*In vitro* mass multiplication techniques: *In vitro* conservation of spice crops. Direct and indirect organogenesis, micro grafting, hardening techniques, production of microrhizomes. *In vitro* breeding: Production of haploids, somaclones and identification of somaclonal variants, *in vitro* techniques to overcome fertilization barriers, Protoplast culture and fusion, construction, identification and characterization of somatic hybrids and cybrids, wide hybridization, embryo rescue of recalcitrant species.

#### Unit -IV: Biotechnological approaches in spice crops II

*In vitro* mutation for biotic and abiotic stresses, disease elimination in crops. Transgenic crops: Recombinant DNA methodology, gene transfer methods, tools, methods, applications of rDNA technology. Role of molecular markers in characterization of transgenic crops, finger printing of cultivars, etc. achievements, problems and future thrusts.

#### Unit -V: Biotechnological approaches in medicinal and aromatic crops

*In vitro* mass multiplication techniques: *In vitro* conservation of medicinal and aromatic crops, direct and indirect organogenesis, micro grafting, hardening techniques, production of microrhizomes. *In vitro* breeding: Production of haploids, somaclones and identification of somaclonal variants, *in vitro* techniques to overcome fertilization barriers, Protoplast culture and fusion, construction, identification and characterization of somatic hybrids and cybrids, wide hybridization, embryo rescue of recalcitrant species, *in vitro* mutation for biotic and abiotic stresses, disease elimination in crops. Transgenic crops: Recombinant DNA methodology, gene transfer methods, tools, methods, applications of rDNA technology. Role of molecular markers in characterization of transgenic crops, finger printing of cultivars etc., achievements, problems

and future thrusts. *In vitro* production of secondary metabolites: In vitro production and characterization of secondary metabolites, bioreactors.

### Lesson plan

1. Introduction and significance, history and basic principles of biotechnology.
2. Scope and importance of biotechnology
3. Techniques of In-vitro cultures, Micropropagation, Anther culture, Pollen culture, Ovule culture, Embryo culture, Test tube fertilization, Endosperm culture.
4. Influence of explant material, physical, chemical factors and growth regulators on growth and development of plant cell, tissue and organ culture.
5. *In vitro* mass multiplication techniques for crop improvement in plantation crops
6. Molecular approaches for crop improvement in plantation crops
7. *In vitro* conservation, Direct and indirect organogenesis and micro grafting
8. Hardening techniques and *ex vitro* establishment of cultured plantlets in plantation crops
9. **1<sup>st</sup> test**
10. *In vitro* breeding: Production of haploids, somaclones and identification of somaclonal variants.
11. *In vitro* techniques to overcome fertilization barriers in plantation crops: Protoplast culture and fusion, construction, identification and characterization of somatic hybrids and cybrids, wide hybridization, embryo rescue of recalcitrant species.
12. *In vitro* mutation for biotic and abiotic stresses in plantation crops
13. *In vitro* mutation for disease elimination in plantation crops
14. Transgenic crops: Recombinant DNA methodology, gene transfer methods, tools, methods, applications of rDNA technology
15. Role of molecular markers in characterization and fingerprinting of transgenic crops, cultivars, etc.,
16. Achievements, problems and future thrusts in biotechnology of plantation crops
17. *In vitro* mass multiplication techniques in crop improvement of spice crops
18. Molecular approaches for crop improvement in spice crops
19. *In vitro* conservation, Direct and indirect organogenesis and micro graftin
20. Hardening techniques and *ex vitro* establishment of cultured plantlets in spice crops
21. *In vitro* breeding: Production of haploids, somaclones and identification of somaclonal variants.
22. *In vitro* techniques to overcome fertilization barriers in spice crops: Protoplast culture and fusion, construction, identification and characterization of somatic hybrids and cybrids, wide hybridization, embryo rescue of recalcitrant species
23. *In vitro* mutation for biotic and abiotic stresses in spice crops
24. *In vitro* mutation for disease elimination in spice crops
25. **First Test**
26. Transgenic crops: Recombinant DNA methodology, gene transfer methods, tools, methods, applications of rDNA technology
27. Role of molecular markers in characterization and fingerprinting of transgenic crops, cultivars, etc.,
28. Achievements, problems and future thrusts in biotechnology in spice crops
29. *In vitro* mass multiplication techniques for crop improvement in medicinal crops

30. Molecular approaches for crop improvement in medicinal crops
31. *In vitro* conservation, Direct and indirect organogenesis and micro grafting
32. Hardening techniques and *ex vitro* establishment of cultured plantlets in medicinal crops
33. Production of micro rhizomes and micro tubers in medicinal crops
34. *In vitro* breeding: Production of haploids, somaclones and identification of somaclonal variants in medicinal crops
35. *In vitro* techniques to overcome fertilization barriers in medicinal crops: Protoplast culture and fusion, construction, identification and characterization of somatic hybrids and cybrids, wide hybridization, embryo rescue of recalcitrant species
36. *In vitro* mutation for biotic and abiotic stresses in medicinal crops
37. *In vitro* mutation for disease elimination in medicinal crops
38. Transgenic crops: Recombinant DNA methodology, gene transfer methods, tools, methods, applications of rDNA technology
39. Role of molecular markers in characterization and finger printing of transgenic crops, cultivars, etc. in medicinal crops
40. *In vitro* production and characterization of secondary metabolites, bioreactors in medicinal crops
41. Achievements, problems and future thrusts in biotechnology of medicinal crops
42. *In vitro* mass multiplication techniques for crop improvement in aromatic crops
43. Molecular approaches for crop improvement in aromatic crops
44. *In vitro* conservation, Direct and indirect organogenesis and micro grafting
45. Hardening techniques and *ex vitro* establishment of cultured plantlets in aromatic crops
46. *In vitro* breeding: Production of haploids, somaclones and identification of somaclonal variants
47. *In vitro* techniques to overcome fertilization barriers in aromatic crops: Protoplast culture and fusion, construction, identification and characterization of somatic hybrids and cybrids, wide hybridization, embryo rescue of recalcitrant species
48. *In vitro* mutation for biotic and abiotic stresses, disease elimination in aromatic crops
49. Transgenic crops: Recombinant DNA methodology, gene transfer methods, tools, methods, applications of rDNA technology
50. Role of molecular markers in characterization and finger printing of transgenic crops, cultivars, etc.
51. Achievements, problems and future thrusts in biotechnology of plantation and spice crops
52. Achievements, problems and future thrusts in biotechnology of medicinal and aromatic crops

### **COURSE OUTCOME**

The learner is expected to be

**CO 1** Acquainted with the applications of biotechnology in PSMA crops

**CO 2** understand basic principles and concepts of biotechnology

**CO 3** understand about molecular markers and their role in breeding of horticultural crops

**CO 4** understand genetic engineering techniques and their achievements

**CO 5** Able to start modern laboratories based on biotechnology in PSMA crops

### CO - PO Mapping matrix

	PO 1	PO 2	PO 3	PO 4	PO 5
CO 1	3	2	2	2	1
CO 2	3	2	3	2	1
CO 3	2	3	2	2	1
CO 4	2	2	3	2	1
CO 5	1	-	2	1	-

### References

1. Afoakwa, E.O. 2016. Cocoa Production and Processing Technology. CRC Press.
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7. Panda, H. 2016. The Complete Book on Cultivation and Manufacture of Tea (2nd Revised Edition). Asia Pacific Business Press Inc.
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### E - Resource

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2. <https://www.cimap.res.in/english/index.php>
3. <https://dmapr.icar.gov.in/>
4. <http://base.dnsgb.com.ua/files/book/Agriculture/PlantBreeding/PlantMolecular-Breeding.pdf>
5. [http://download.bioon.com.cn/upload/201105/28152813\\_8350.pdf](http://download.bioon.com.cn/upload/201105/28152813_8350.pdf)
6. <http://cdn.intechopen.com/pdfs-wm/40178.pd>

### PSM - 606 ABIOTIC STRESS MANAGEMENT IN PLANTATION, SPICE, MEDICINAL AND AROMATIC CROPS (2+1)

### Learning objectives

- This course is designed for the learner to understand the influence of climatic and environmental stress on PSMA crops.
- To enlighten students on effect on global warming in growth of PSMA crops.
- The course aims to impart knowledge on the changes brought out due to abiotic stress factors on growth, yield and quality attributes of PSMA crops
- The course highlights measures to mitigate abiotic stress on PSMA crops.

- The course aims to impart knowledge on the advanced approaches in the management of various stresses.

## **Theory**

### **Unit-I: Abiotic Stress**

Definition, soil conditions (salinity, alkalinity, ion toxicity, fertilizer toxicity, etc.), salt stress Temperature and water stress: Stresses due to water (high and low), temperature (high and low), symptoms, mechanisms governing tolerance, associated physiological and biochemical factors, impact on PSMA crops and produce, changes in phenology and quality. Stress due to soil conditions and salts: Alkainity, salinity, iron toxicity, fertilizer toxicity symptoms, mechanisms governing tolerance, associated physiological and biochemical factors, impact on PSMA crops and produce, changes in phenology and quality

### **Unit-II: Pollution stress**

Gaseous pollutants and heavy metals, symptoms, mechanisms governing tolerance, associated physiological and biochemical factors, impact on PSMA crops and produce, changes in phenology and quality. Other stresses: Stress due to radiation, wind, nutrients. symptoms, mechanisms governing tolerance, associated physiological and biochemical factors , impact on PSMA crops and produce, changes in phenology and quality.

### **Unit- III: Contributing factors**

Introduction to climate change, factors contributing to climate change, change in temperature, rainfall, humidity, rise in the atmospheric CO<sub>2</sub> levels, tropospheric ozone levels, extreme climatic events. Carbon trading: Global warming, carbon trading, role of green house gases, impact on productivity of PSMA crops. Clean development mechanism.

### **Unit -IV: Impact of climate change on PSMA crops**

Plantation crops, Spice crops, Medicinal and aromatic crops Climate resilient technologies: Varieties (Plantation crops, Spice crops, Medicinal and aromatic crops)

### **Unit -V: Climate resilient technologies**

Plantation crops, Spice crops, Medicinal and aromatic crops. Waste management: Alternate farming systems, Zero waste management, Microbial waste management

### **Practicals**

Analysis of plant stress factors, Relative water content, Chlorophyll stability index, Plant waxes, Stomatal diffusive resistance, Transpiration, Photosynthetic rates. Calculation of water use efficiency and growth rates, Identifying abiotic stress symptoms and injuries, Use of anti-transpirants, Managing nutrient stress, Stress management by hormones, Screening for abiotic stress tolerance, Weather data analyses and quantification of climate change, Cropping pattern changes due to climate extremities, Phenological and quality changes in PSMA crops and Pesticide residue analysis in PSMA crops.

### **Lesson plan**

1. Abiotic Stress: Definition, soil conditions (salinity, alkalinity, ion toxicity, fertilizer toxicity, etc.), salt stress
2. Temperature and water stress: Stresses due to water (high and low), temperature (high and low) and symptoms
3. Mechanisms governing tolerance, associated physiological and biochemical factors to water stress
4. Mechanisms governing tolerance, associated physiological and biochemical factors Temperature stress



5. Mechanisms governing tolerance, associated physiological and biochemical factors water stress on PSMA crops
  6. Impact of water (low & high) on PSMA crops and their produces
  7. Impact of temperature (low & high) on PSMA crops and their produces
  8. Changes in phenology and quality due to water stress in PSMA crops
  9. Changes in phenology and quality due to temperature stress in PSMA crops
  10. Pollution stress: Gaseous pollutants and heavy metals and symptoms of pollution stress in PSMA crops
  11. Mechanisms governing tolerance, associated physiological and biochemical factors to pollution stress in PSMA crops
  12. Impact of pollution stress on PSMA crops and their produces
  13. Changes in phenology and quality due to pollution stress in PSMA crops
  14. Other stresses: Stress due to radiation, wind, nutrients and symptoms in PSMA crops
  15. Mechanisms governing tolerance, associated physiological and biochemical factors in PSMA crops
  16. Impact of radiation, wind and nutrient stress in PSMA crops and Changes in phenology and quality due to nutrient stress in PSMA crops
  17. **First Test**
  18. Contributing factors: Introduction to climate change, factors contributing to climate change
  19. Effect of changes in temperature, rainfall and humidity in PSMA crops
  20. Effect of changes in rise in the atmospheric CO<sub>2</sub> levels, tropospheric ozone levels, extreme climatic events in PSMA crops
  21. Effect of global warming and carbon trading
  22. Role of greenhouse gases on global warming and their impact on PSMA crops
  23. Impact of global warming on productivity of PSMA crops
  24. Clean development mechanism
  25. Impact of climate change on Plantation crops
  26. Impact of climate change on Spice crops
  27. Impact of climate change on Medicinal crops
  28. Impact of climate change on Aromatic crops
  29. Climate resilient Varieties in plantation and spice crops
  30. Climate resilient Varieties in medicinal and aromatic crops
  31. Climate resilient technologies: Plantation crops, Spice crops, Medicinal and aromatic crops.
  32. Waste management / Alternate farming systems for PSMA crops
  33. Zero waste management
  34. Microbial waste management in PSMA crops
- Practical schedule**
1. Analysis of plant stress factors
  2. Estimation of relative water content in drought tolerant spices
  3. Estimation of Chlorophyll stability index for abiotic stress
  4. Plant waxes
  5. Stomatal diffusive resistance
  6. Estimation of transpiration rates in PSMA crops
  7. Assessment of Photosynthetic rates in PSMA crops

8. Calculation of water use efficiency and growth rates
9. Identifying abiotic stress symptoms and injuries in PSMA crops
10. Use of anti-transpirants in PSMA crops
11. Study of nutrient deficiency symptoms and their corrective measures in PSMA crops
12. Stress management by hormones in seed spices
13. Screening for abiotic stress tolerance in medicinal plants
14. Weather data analyses and
15. Quantification of climate change
16. Cropping pattern changes due to climate extremities
17. Pesticide residue analysis in PSMA crop

### **COURSE OUTCOME**

**CO 1-** The learner is expected to gain knowledge on the impact of various climatic and environmental factors on PSMA crops.

**CO 2-** The learner is expected to get empowered on the impact of abiotic stress on plantation and spice crop production.

**CO 3-** The learner is expected to get empowered on the impact of abiotic stress on medicinal and aromatic crop production.

**CO 4-** The mitigation measures to be adopted for sustaining plantation and spice crop production.

**CO 5-** The mitigation measures to be adopted for sustaining medicinal and aromatic crop production.

### **CO - PO Mapping matrix**

	<b>PO 1</b>	<b>PO 2</b>	<b>PO 3</b>	<b>PO 4</b>	<b>PO 5</b>
<b>CO 1</b>	3	3	3	3	3
<b>CO 2</b>	2	1	2	3	2
<b>CO 3</b>	2	1	2	3	2
<b>CO 4</b>	1	2	3	3	1
<b>CO 5</b>	1	2	3	3	1

### **References**

1. Afoakwa, E.O. 2016. Cocoa Production and Processing Technology. CRC Press.
2. E-manual on Advances in Cashew Production Technology. ICAR- Directorate of Cashew Research, Puttur- 574 202, D.K., Karnataka.
3. Ahmad, Parvaiz, M.N.V. and Prasad, 2012. Abiotic Stress Responses in Plants Metabolism, Productivity and Sustainability. Springer.
4. Harish Chandra Prasad, Rao, Nadipynayakanahally Krishnamurthy Sriniv, Shivashankar, KodthaluSeetharamaiah. 2013. Climate-Resilient Horticulture: Adaptation and Mitigation Strategies. Springer. Panda, H. 2013.
5. Hebbar, K.B., Kumar, S.N., and Choudappa, P. 2017. Impact of climate change on Plantation Crops.
6. Daya Publishing House, New Delhi. Jenks, M.A. and Hasegawa, P.M. 2003. Plant Abiotic Stress. Black Well.
7. Mussell, H. and Staples, R. 1979. Stress Physiology in Crop Plants. Wiley Inter. Science.
8. Nickell, L.G. 1983. Plant Growth Regulating Chemicals. CRC Press.

### **E - Resource**

1. <http://www.plantphysiol.org/>
2. [www.dbtindia.nic.in](http://www.dbtindia.nic.in)
3. [www.nre.vic.gov.au](http://www.nre.vic.gov.au)
4. [www.agritech.tnau.ac.in](http://www.agritech.tnau.ac.in)

## PSM - 607 ORGANIC SPICE AND PLANTATION CROPS PRODUCTION (2+1)

### Learning objectives

- This course is designed to give comprehensive knowledge on scientific organic farming technology in plantation and spice crops.
- To impart knowledge on principles, concepts and techniques of organic farming in spice and plantation crops.
- To impart knowledge on certification procedures of organic farming in spice and plantation crops.
- To collect ideas of quality control management of spices and plantation crops.
- To collect ideas of organic production and certification of spices and plantation crops.

### Theory

#### Unit -I: Concepts of Organic Farming

Principles, perspectives, concepts and components of organic farming, present status of organic farming at national and global level, domestic and global demand for organic products with respect to spice and plantation crops, organic production and export - opportunities and challenges

#### Unit -II: Organic Conversion Plan

Advanced methods for enhancing soil fertility, soil amendments. Modern methods of composting, vermicomposting, coir pith composting, bio fertilizers, pest and disease management in organic farming; crop rotation in organic horticulture, weed management, botanicals and bio- control agents.

#### Unit -III: Organic Farming Systems

Natural farming, permaculture, biodynamic farming, Zero budget farming, Homa farming, EM technology. Unit

#### Unit -IV: Organic Production Technology

Coconut, Coffee, Cocoa, Tea - Major Spices: Black pepper, Cardamom, Ginger, Turmeric, Vanilla - Seed spices: Coriander, Cumin, Fennel, Fenugreek.

#### Unit -V: Certification and Quality Control

Accreditation agencies, certification agencies, procedure of certification, types of certification - Organic standards: Domestic and international standards, NPOP, IFOAM, CODEX, HACCP standards - Quality control: Participatory Guarantee System (PGS) in quality control, quality control for organic products.

### Practical

Coir composting techniques, vermicomposting, Waste management techniques Biodynamic preparations, production of Biopesticides and Biofertilizers , Visit to certification and marketing centers, organic fields of Spice and Plantation crops.

### Lesson plan

1. Principles, perspectives, concepts and components of organic farming with respect to Spice Crops
2. Principles, perspectives, concepts and components of organic farming with respect to Plantation Crops
3. Present status of organic farming at national and global level, domestic and global demand for organic products with respect to spice crops
4. Present status of organic farming at national and global level, domestic and global demand for organic products with respect to plantation crops
5. Export - opportunities and challenges for organic Spice Crops
6. Export - opportunities and challenges for organic Plantation Crops
7. Advanced methods for enhancing soil fertility and soil amendments for organic cultivation of Spice crops
8. Advanced methods for enhancing soil fertility and soil amendments for organic cultivation of Plantation crops
9. Modern methods of composting, vermicomposting, coir pith composting and bio fertilizers
10. Pest and disease management in organic farming of Spice crops
11. Pest and disease management in organic farming of Plantation crops
12. Crop rotation and weed management in organic cultivation of Spice crops
13. Crop rotation and weed management in organic cultivation of Plantation crops
14. Uses of botanicals and bio-control agents in organic cultivation of Spice crops
15. Uses of botanicals and bio-control agents in organic cultivation of Plantation crops
16. Organic Farming Systems viz., Natural farming, permaculture, biodynamic farming, Zero budget farming, Homa farming and EM technology
17. **First Test**
18. Organic Production Technology of Coconut
19. Coffee
20. Cocoa
21. Tea
22. pepper
23. Cardamom
24. Ginger
25. Turmeric
26. Vanilla
27. Coriander and Fenugreek
28. Cumin and Fennel
29. Accreditation agencies, certification agencies, procedure of certification, types of certification of Spices Crops
30. Accreditation agencies, certification agencies, procedure of certification, types of certification of Plantation Crops
31. Domestic and international organic standards, NPOP, IFOAM, CODEX, HACCP standards of Spices Crops
32. Domestic and international organic standards, NPOP, IFOAM, CODEX, HACCP standards of Plantation Crops
33. Participatory Guarantee System (PGS) in quality control, quality control for organic products of Spices Crops

34. Participatory Guarantee System (PGS) in quality control, quality control for organic products of Plantation Crops

**Practical**

1. Study of coir composting techniques
2. Study of vermicomposting
3. Estimation of pesticide residue of Spice products
4. Estimation of pesticide residue of products of Plantation crops
5. Zero-budget preparations
6. Composting techniques and
7. Enrichment of composts
8. Waste management techniques
9. AMF in organic production
10. Biodynamic preparations
11. Studying the methods of production of Bio-pesticides
12. Visit to the plant of bio-fertilizers
13. Visit to the plant of bio control agents
14. Visit to certification and marketing centers
15. Exposure visit to organic fields of Spice crops
16. Exposure visit to organic fields of Plantation crops
17. Exposure visit to organic fields of seeds spices

**COURSE OUTCOME**

**CO 1** The learner is expected to get empowered on the organic farming techniques in spice crops.

**CO 2** The learner is expected to get empowered on the organic farming techniques in plantation crops.

**CO 3** The organic certification procedures in spice and plantation crops.

**CO 4** The learner empowered on quality control management of spices crops.

**CO 5** The learner empowered on quality control management of plantation crops.

**CO - PO Mapping matrix**

	<b>PO 1</b>	<b>PO 2</b>	<b>PO 3</b>	<b>PO 4</b>	<b>PO 5</b>
<b>CO 1</b>	<b>2</b>	<b>2</b>	<b>2</b>	<b>3</b>	<b>1</b>
<b>CO 2</b>	<b>2</b>	<b>2</b>	<b>2</b>	<b>3</b>	<b>1</b>
<b>CO 3</b>	-	-	-	-	-
<b>CO 4</b>	<b>1</b>	-	<b>1</b>	<b>2</b>	<b>1</b>
<b>CO 5</b>	<b>1</b>	-	<b>1</b>	<b>2</b>	<b>1</b>

**References**

1. Dahama, A.K. 2005. Organic Farming for Sustainable Agriculture. 2nd Ed. Agrobios.
2. E-manual on Advances in Cashew Production Technology. ICAR- Directorate of Cashew Research, Puttur - 574 202, D.K., Karnataka 1761
3. Gehlot, G. 2005. Organic Farming: Standards, Accreditation, Certification and Inspection. Agrobios
4. Palaniappan, S.P. and Annadarai, K. 2003. Organic Farming: Theory and Practice. Scientific Publ.
5. Panda, H. 2013. The Complete Book on Cashew. Asia Pacific Business Press Inc.

6. Panda, H. 2016. The Complete Book on Cultivation and Manufacture of Tea (2nd Revised Edition). Asia Pacific Business Press Inc
7. Parthasarthy, V.A., Kandiannan, V., and Srinivasan, V. 2008. Organic Spices. New India Publ. Agency.
8. Pradeepkumar, T., Suma, B., Jyothibhaskar, and Satheesan, K.N. 2008. Management of Horticultural Crops. New India Publ. Agency.
9. Sera, T., Soccol, C.R., Pandey, A., Roussos, S. Coffee Biotechnology and Quality. Springer, Dordrecht.

#### **E - Resource**

1. [https://niti.gov.in/planningcommission.gov.in/docs/aboutus/committee/wrkgrp11/wg11\\_aghorti.pdf](https://niti.gov.in/planningcommission.gov.in/docs/aboutus/committee/wrkgrp11/wg11_aghorti.pdf)
2. <http://www.indianspicesociety.in/iss/pdf/20.%20Organic%20farming%20in%20three%20spices%20-%20Spice%20India.pdf>
3. <http://www.indianspices.com/spices-development/organic-spices.html>
4. <https://cochinspices.com/organic-spices/>
5. [https://apeda.gov.in/apedawebsite/organic/organic\\_contents/Appendix\\_1\\_Crop%20Production.pdf](https://apeda.gov.in/apedawebsite/organic/organic_contents/Appendix_1_Crop%20Production.pdf)

### **PSM - 608 MARKETING AND EXPORT OF PLANTATION, SPICE, MEDICINAL AND AROMATIC CROPS (2+1)**

#### **Learning objectives**

- This course is designed to impart in the learner a deeper understanding on
- marketing and trade of
- Raw materials and value added products at the domestic level of
- plantation crops
- spice crops
- medicinal crops and
- aromatic crops

#### **Theory**

Importance of marketing and trade - Market opportunities - Marketing strategies - Marketing Channels - Supply chain management and total quality management - Entrepreneurship development - Decision making - Price structure.

#### **Unit -I: Importance of marketing and trade**

Market opportunities and challenges in PSMA crops at the domestic and global level, consumption in India's plantation, herbal and spice and other industries, Demand-supply scenario of PSMA's at the national and international level, Marketing and trade in raw materials and value added products - Direct and indirect marketing, niche marketing, specialty markets, market intermediaries and their role, market infrastructure needs, marketing efficiency. market organization, planning, promotion, cost control, contract farming.

#### **Unit -II: Marketing Channels**

Marketing co-operatives including tribal co-operatives, public private partnerships (PPP), Farmer Producer Companies (FPC) and Farmer Producer Organisations (FPOs).

#### **Unit -III: Supply chain management**

Good transportation procedures, cold storage facilities, State trading, warehousing and other govt. agencies. Role of commodity boards and export promotion councils in marketing and export of PSMA crops

#### **Unit -IV: Entrepreneurship development**

Risk taking, motivation, importance of planning, monitoring, evaluation and follow up, SWOT analysis, generation, incubation and commercialization of ideas and innovations. Communication skills, domestic and export market intelligence, export standards .Role of information technology and telecommunication in marketing of PSMA's.

#### **Unit -V: Price analysis**

Price analysis and price forecasting in PSMA crops, policies on export, import and re-export of commodities and value added products, guidelines for marketing of organic produce and organic products.

#### **Practicals**

Study of requirement of various raw materials by the plantation, spice and Ayurveda Industries - Demand supply analysis of various PSMA crops - Exposure visit to trading centres, exporters, ware houses, value addition units etc - Study of FPOs and FPCs in various crops. Preparation and evaluation of projects - Documentation of case studies.

#### **Lesson plan**

1. Market opportunities and challenges in Plantation and Spice crops at the domestic and global level
2. Market opportunities and challenges in Medicinal and Aromatic Crops at the domestic and global level
3. Consumption in India's plantation, herbal and spice and other industries
4. Demand-supply scenario of Plantation and Spice crops at the national and international level
5. Demand-supply scenario of Medicinal and Aromatic Crops at the national and international level
6. Marketing and trade in raw materials and value added products of Plantation and Spice crops
7. Marketing and trade in raw materials and value added products of Medicinal and Aromatic Crops
8. Direct and indirect marketing, niche marketing, specialty Markets of Plantation and Spices
9. Direct and indirect marketing, niche marketing, specialty Markets of Medicinal and Aromatic Crops
10. Market intermediaries and their role, market infrastructure needs, marketing efficiency of PSMA Crops
11. Market organization, planning, promotion, cost control, contract farming of Plantation and Spice crops
12. Market organization, planning, promotion, cost control, contract farming of Medicinal and Aromatic Crops
13. Marketing co-operatives including tribal co- operatives for PSMA Crops
14. Public private partnerships (PPP), Farmer Producer Companies (FPC) and Farmer Producer Organizations (FPOs) for Plantation and Spice crops
15. Public private partnerships (PPP), Farmer Producer Companies (FPC) and Farmer Producer Organizations (FPOs) for Medicinal and Aromatic Crops.

16. Supply chain management and total quality management Good transportation procedures, cold storage facilities, State trading, warehousing and other govt. agencies of Plantation and Spice crop
17. **First Test**
18. Supply chain management and total quality management Good transportation procedures, cold storage facilities, State trading, warehousing and other govt. agencies of Medicinal and Aromatic Crops
19. Role of commodity boards and export promotion councils in marketing and export of Plantation and Spice crops
20. Role of commodity boards and export promotion councils in marketing and export of Medicinal and Aromatic Crops
21. Decision making: Risk taking, motivation, importance of planning, monitoring, Evaluation of PSMA Crops
22. SWOT analysis, generation, incubation and commercialization of ideas and innovations in Plantation and Spice crops
23. SWOT analysis, generation, incubation and commercialization of ideas and innovations in Medicinal and Aromatic Crops
24. Communication skills, domestic and export market intelligence, export standards of Plantation and Spice crops
25. Communication skills, domestic and export market intelligence, export standards of Medicinal and Aromatic Crops
26. Role of information technology and telecommunication in marketing of PSMA's
27. Price structure: Price analysis and price forecasting in Plantation and Spice crops
28. Price structure: Price analysis and price forecasting in Medicinal and Aromatic Crops
29. Policies on export, import and re-export of commodities of Plantation and Spice crops
30. Policies on export, import and re-export of commodities of Medicinal and Aromatic Crops
31. Policies on export, import and re-export of Value added products Plantation and Spice crops
32. Policies on export, import and re-export of Value added products Medicinal and Aromatic Crops
33. Guidelines for marketing of organic produce and organic products of Plantation and Spice crops
34. Guidelines for marketing of organic produce and organic products of Medicinal and Aromatic Crops

### **Practical schedule**

1. Study of requirement of various raw materials by the plantation, spice and ayurveda industries
2. Study of requirement of various raw materials by the Medicinal and Aromatic Crops and ayurveda industries
3. Demand supply analysis of various Plantation and spice crops
4. Demand supply analysis of various Medicinal and Aromatic Crops
5. Preparation and evaluation of projects related to Plantation and spice crops
6. Preparation and evaluation of projects related to Medicinal and Aromatic Crops
7. Documentation of case studies relevant to Plantation and spice crops
8. Documentation of case studies relevant to Medicinal and Aromatic Crops
9. Visit to Marketing Co-operatives of PSMA Crops



10. Visit to Farmer Producer Companies (FPC) and Farmer Producer Organizations (FPOs) of Plantation and spice crops
11. Visit to Farmer Producer Companies (FPC)
12. Farmer Producer Organizations (FPOs) of Medicinal and Aromatic Crops
13. Visit to cold storage units and warehousing agencies of PSMA Crops
14. Visit to Food Processing and value added products of Plantation and spice crops
15. Visit to Food Processing and value added products of Medicinal and Aromatic Crops
16. Visit to organic farms and organic products companies of PSMA Crops
17. Visit to export units of PSMA Crops

### **COURSE OUTCOME**

**CO 1** The learner is expected to get empowered on the marketing and trade opportunities and channels in plantation and spice crops

**CO 2** The learner is expected to get empowered on the marketing and trade opportunities and channels in medicinal and aromatic crops

**CO 3** The entrepreneurs development and value chain in plantation and spice crops

**CO 4** The entrepreneurs development and value chain in medicinal and aromatic crops

**CO 5** Decision support and pricing system in PSMA crops.

### **CO - PO Mapping matrix**

	<b>PO 1</b>	<b>PO 2</b>	<b>PO 3</b>	<b>PO 4</b>	<b>PO 5</b>
<b>CO 1</b>	1	-	-	3	1
<b>CO 2</b>	1	-	-	3	1
<b>CO 3</b>	1	-	-	2	2
<b>CO 4</b>	1	-	-	2	2
<b>CO 5</b>	-	-	-	2	1

### **References**

1. Chinnappa, B. 2018. Economics and marketing of Arecanut in India. Narendra Publishing House, New Delhi.
2. E-manual on Advances in Cashew Production Technology. ICAR- Directorate of Cashew Research, Puttur -574 202, D.K., Karnataka.
3. Holly, J. and Cheria, K. 1998. The medicinal plant Sector in India. Medicinal and Aromatic Programme in Asia (MAPP), New Delhi, India.
4. Panda, H. 2013. The Complete Book on Cashew. Asia Pacific Business Press Inc.
5. Panda, H. 2016. The Complete Book on Cultivation and Manufacture of Tea (2nd Revised Edition). Asia Pacific Business Press Inc.

### **E - Resource**

1. [https; / www.nmpb.nic.in](https://www.nmpb.nic.in)
2. [https; / www.indian spices.com](https://www.indianspices.com)
3. [https; / www.ibef.org](https://www.ibef.org)

## COM 601 Advances in computer applications (1+1)

### Objective learning

- After completion of this unit of module, candidate will be able to
- Gain the knowledge about documentation on open source tool.
- To understand the Working knowledge of Latex typesetting language
- Understand features of Python that make it one the most popular languages in the industry.
- Understand the areas where Python is used.

### Theory

#### Unit I Introduction to Latex:

Introduction to Latex – What is Latex – Document Structure, Start Text works, Title, Section, Table of content – Typesetting Text, Font Effects, Coloured Text, Font Size, List, Comments & Spacing, Special Characters.

#### Unit II Packages and Classes in Latex:

Inserting Equations – Mathematical Symbols – Table of Content – Generating New Command – Figure handling numbering, List of figure, List of Tables.

Packages – Geometry, Hyperref, amsmath, amssymbol – Classes – Article, Book, Report – The BibTex file – Inserting Bibliography – Citing – References.

#### Unit III MS Access:

MSACCESS: Database, concepts and types - Uses of DBMS in Agriculture; creating database.

#### Unit IV Introduction to Python:

Python Introduction, Technical Strength of Python, Introduction to Python Interpreter and program execution, Using Comments, Literals, Constants, Python's Built-in Data types, Numbers (Integers, Floats, Complex Numbers, Real, Sets), Strings (Slicing, Indexing, Concatenation, other operations on Strings), Accepting input from Console, printing statements, Simple 'Python' programs.

#### Unit V Using Databases in Python:

Database Programming: Connecting to a database, Creating Tables, INSERT, UPDATE, DELETE and READ operations, Transaction Control, Disconnecting from a database.

### Lesson plan

1. Introduction to Latex.
2. Document Structure.
3. Classes.
4. Typesetting Text.
5. Inserting Equations
6. Packages and Mathematical Symbols.
7. List of figure.
8. List of Tables.
9. Bibliography and References.
10. **Mid Semester Examination**
11. MS Access Concepts of Database, Creating Database.
12. DBMS in Agriculture.

13. Introduction to Python.
14. Built-in Data types.
15. Strings.
16. Python Console.
17. Database in Python.

#### Practicals

1. Installation of Latex, Basic Latex commands.
2. Latex Compilation, Page Layout.
3. Building a Latex document, Previewing first.tex.
4. Addition of some text in the.tex file, Finding the error and fixing it.
5. Type setting of mathematics, Writing equations, matrix.
6. Two figure next to each other, Formation of table
7. Typesetting with a new chapter heading, List of figures, List of tables.
8. Citation, Bibliography, printing your document
9. MSACCESS: Creating Database, preparing queries and reports.
10. MSACCESS: Demonstration of Agri-information system.
11. Introduction to Python, Working with Data.
12. Program Organization, Functions, and Modules, Classes and Objects.
13. Inside the Python Object System.
14. Testing, Debugging, and Software Development Practice.
15. Packages.

#### COURSE OUTCOMES

At the end of the course students will be able to

**CO 1:** Problem solving and programming capability.

**CO 2:** Analyse common problems using Latex.

**CO 3:** Learn categories of programs.

**CO 4:** Construct and execute basic programs in Python..

**CO 5:** Use external libraries and packages with Python.

#### CO-PO MAPPING MATRIX

	PO 1	PO2	PO3	PO4	PO5	PO6
CO1	3	3	3	3	3	3
CO2	0	1	3	1	2	2
CO3	0	3	2	3	2	2
CO4	3	0	0	0	3	0
CO 5	0	3	2	0	1	3

#### References

1. Introduction to Latex by Tobias Oetiker
2. LaTeX: A Document Preparation System, 2nd Edition By [Leslie Lamport](#)

3. Charles Dierbach, "Introduction to Computer Science using Python", Wiley, 2015
4. Python Programming- A modular Approach (with Graphics, database, Mobile and Web Applications by Sheetal Taneja and Naveen Kumar, Pearson.
5. Head First Python by Paul Berry, O'Reilly

### **E-Resources**

1. [https://www.overleaf.com/learn/latex/Bibliography\\_management\\_with\\_bibtex](https://www.overleaf.com/learn/latex/Bibliography_management_with_bibtex)
2. [https://en.wikibooks.org/wiki/LaTeX/Bibliography\\_Management](https://en.wikibooks.org/wiki/LaTeX/Bibliography_Management).
3. <https://wiki.python.org/moin/PythonBooks>.
4. <https://devfreebooks.github.io/python/>
5. <https://www.digitalocean.com/community/books/digitalocean-ebook-how-to-code-in-python>.