ANNAMALAI UNIVERSITY

ANNAMALAINAGAR

M.Sc(Horticulture)

DEGREE PROGRAMMES

REVISED SYLLABUS

2018-2019

FACULTY OF AGRICULTURE
COMMON REGULATIONS FOR ALL MASTER OF SCIENCE (AGRICULTURE/HORTICULTURE) PROGRAMMES OFFERED BY THE FACULTY OF AGRICULTURE
With Effect From 2018-2019

1. Short title and commencement

- **These rules and regulations shall govern the post graduate studies leading to the award of degree of Master of Science (Agriculture/Horticulture)in the Faculty of Agriculture.**
- **They shall come into force with effect from the academic year 2018 – 2019.**

2. Definitions

- **An "Academic Year" shall consist of two semesters.**
- **"Semester" means an academic term consisting of 110 working days including final theory examinations.**
- **"Subject" means a unit of instruction to be covered in a semester having specific No., title and credits.**
- **"Credit hour" means, one hour lecture plus two hours of library or home work or two and half hours of laboratory/field practical per week in a semester.**
- **"Grade Point of a subject" means the value obtained by dividing the percentage of marks earned in a subject by 10 and the Grade Point is expressed on a 10 point scale.**
- **"Credit Point" means the grade point multiplied by credit hours.**
- **"Grade Point Average" (GPA) means the quotient of the total credit points obtained by a student in various subjects 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 point scale and the GPA has to be corrected to two decimals.**
- **"Overall Grade Point Average" (OGPA) means the quotient of cumulative credit points obtained by a student in all the subjects 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.**

3. Courses offered

The details of various post-graduate degree programmes at Masters' level offered in the Faculty of Agriculture are as follows:

- **Agronomy**
- **Agricultural Entomology**
- **Agricultural Microbiology**
- **Genetics and Plant Breeding**
- **Seed Science and Technology**
- **Agricultural Biotechnology**
- **Horticulture**
- **Fruit Science**
- **Vegetable Science**
- **Floriculture and Landscape Architecture**
- **Plantation, Spices, Medicinal and Aromatic Crops**
- **Plant Pathology**
- **Soil Science and Agricultural Chemistry**
- **Agricultural Extension**
- **Agricultural Economics**

4. Eligibility for admission

Candidates for admission to the M.Sc.(Ag/Hort.) programme should satisfy the following requirements.

4.1. Candidates seeking admission to the M.Sc. (Ag./Hort.) Degree programme should have completed any one of the following four year degree programmes from Universities recognized by Annamalai University.

- **M.Sc. (Ag.) Agronomy, Agricultural Entomology, Genetics and Plant Breeding, Plant Pathology, Soil Science and Agricultural Chemistry, Seed Science and Technology and Agricultural Bio technology.**
  B.Sc. (Hons.) Agriculture / B.Sc.(Hons.) Horticulture/ B.Sc. (Ag.) / B.Sc.(Hort.) / B.Tech.(Hort.) / B.Sc.(Forestry) / B.Tech.(Agri. Bio-tech.) courses of four years duration of a recognized university.
- **M.Sc. (Ag.) Agricultural Microbiology**
  B.Sc. (Hons.) Agriculture / B.Sc.(Hons.) Horticulture/B.Sc. (Ag.)/B.Sc.(Hort.) /B.Tech.(Hort.)/ B.Sc.(Forestry)/B.E.(Agri.)/B.V.Sc./ B.F.Sc. B.Tech.(Agri. Bio-tech.)/ B.Sc. (Dairy Science)/ B.Sc. (Home Science) courses of four years duration of a recognized university.
- **M.Sc. (Ag.) Agricultural Economics**
  B.Sc. (Hons.) Agriculture / B.Sc.(Hons.) Horticulture/ B.Sc. (Ag.)/B.Sc.(Hort.) /B.Tech.(Hort.)/ B.Sc. (Forestry)/ B.Tech.(Agri. Bio-tech.) any other four year degree courses offered by Agriculture/ Veterinary/Fisheries Universities
- **M.Sc. (Ag.) Agricultural Extension**
  B.Sc. (Hons.) Agriculture / B.Sc.(Hons.) Horticulture/ B.Sc. (Ag.)/B.Sc.(Hort.)/B.Tech.(Hort.)/ B.Sc.(Forestry)/B.E.(Agri.)/B.V.Sc./ B.F.Sc. B.Tech.(Agri. Bio-tech.)/ B.Sc. (Sericulture) / B.Sc. (Dairy Science)/ B.Sc. (Home Science) courses of four years duration of a recognized university.

e. M.Sc. (Hort.)
B.Sc. (Hons.) Agriculture / B.Sc.(Hons.) Horticulture/ B.Sc.(Hort.) / B.Tech.(Hort.) / B.Sc. (Ag.) / B.Tech.(Agri. Bio-tech.) courses of four years duration of a recognized university.

4.2. Candidates who have undergone the programme under conventional system should possess not less than a second class Bachelor's degree. The candidates under 4 point grade systems should possess a minimum OGPA of 2.5 out of 4.00 and 2.75 out of 4.00 in the subject concerneded. For those under 10 point system a minimum OGPA of 6.00 out of 10.00 and 6.50 out of 10.00 in the subject concerneded is required. However, this will not apply to SC/ST candidates for whom a pass in the degree concerneded is sufficient.

*4.3.***An entrance test will be held separately for each Degree programme. Candidates shall be required to be present on the specified date and time for written test and interview at their own expenses.**

5.1. Duration of the programme

The duration for the M.Sc. (Agriculture/Horticulture) programme will be of two years with four semesters. A student registered for Full- time M.Sc. (Agriculture/Horticulture) programme should complete the course within four years from the date of his/Her admission.

5.2 Credit Grade Point Requirements

A student enrolled for the Master's degree programme to earn eligibility for the degree is required to complete 55 credits as detailed below.

i) Major Subjects	**20**
ii) Minor Subjects	**9**
iii) Supporting subjects	**5**
iv) Seminar	**1**
vi) Research	**20**
Total credits	**55**

Minor courses: Minor courses are to be chosen by the students from the related discipline in consultation with the Head of the department and the Chairman based on their research specialization.

5.3 Non- credit Compulsory courses

Subject code	COURSE TITLE	Departments offer the subjects	Credit
1	PGS 611	Agricultural research ethics and methodology Research ethics (Agricultural extension) Research data analysis (Agricultural economics)	0 + 1
2	PGS 612	Technical writing and communication skills	0 + 1
3	PGS 623	Basic concepts in laboratory techniques Laboratory techniques for audio and video production (Agricultural extension) Basic Analytical techniques(Agricultural economics)	0+1
4	PGS 624	Library and information services (Library science)	0+1
5	PGS 715 e-course	Intellectual property and its management in agriculture (Agrl. Economics)	1+0
6	PGS 716 e-course	Disaster management (Agronomy)	1+0
			2 + 4=6

5.4. Minimum Grade point requirement

A post graduate student should maintain a minimum Grade Point of 6.50 out of 10 to secure a pass in a subject. In the subjects in whom a student fails, he/she has to reappear for the examination to get a pass in that subject.

6. Attendance requirement

6.1. One hundred per cent attendance is expected of each student. A student, who fails to secure a minimum of 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 will be required to repeat the subject when ever offered.

In case of new admission, who are permitted to join late due to administrative reasons, the attendance will be calculated from the date of joining of the student. However, for genuine reasons, condonation of attendance deficiency may be considered by the Vice-Chancellor on the recommendation of the Head of the Department and the Dean, Faculty of Agriculture on payment of condonation fee prescribed by the University.

6.2 Students absenting from the classes with prior permission of the Head of the Department/Dean, Faculty of Agriculture on official University business shall be given due consideration in computing attendance.

7. Advisory Committee

7.1. Each post-graduate student shall have an Advisory Committee to guide him/her in carrying out the research programme. The Advisory Committee shall comprise a Major Adviser (Chairman) and two members. Of the two members, one will be from the same Department and the other in the related field from the other Departments of Faculty of Agriculture. The Advisory Committee shall be constituted within three weeks from the date of commencement of the first semester.

7.2 For interdisciplinary research requiring expertise from teaching staff of other faculties, due permission need to be obtained from the Dean, Faculty of Agriculture to nominate them as Technical advisors. An official letter in this regard needs to be communicated to the individual concerned. However, they are restrained from the evaluation of Research/Seminar evaluation.

7.3. Major Adviser (Chairman)

Every student shall have a Major Adviser who will be from his/her major field of studies. The appointment of Major Adviser (Chairman) shall be made by the Head of the Department concerneded. The chairman in consultation with the Head of the Department will nominate the other two members. In the event of the Major Adviser being away on other duty/leave for a period of more than three months,

the member of the Advisory Committee from the same Department will officiate as the Major Adviser.

7.4. Guidelines on the duties of the Advisory Committee

- **Guiding students in drawing the outline of research work**
- **Guidance throughout the programme of study of the students.**
- **Evaluation of research and seminar credits.**
- **Correction and finalization of thesis draft.**
- **Conduct of qualifying and final Viva-Voce examination.**
- **The proceedings of the Advisory Committee will be sent to the Head of the Department concerneded within 10 working days.**
- **Periodical review of the Advisory Committee proceedings will be made by the Head of the Department concerneded.**

8.Programme of Study

8.1 The student's plan for the post-graduate work, drawn up by the Advisory Committee, shall be finalized before the end of the first semester.

8.2 The programme shall be planned by the Advisory Committee taking into account his/her previous academic training and interest.

8.3 Programme of research work

The outline of research work of the student, in the prescribed manner and as approved by the Advisory Committee, shall be forwarded by the Chairman to the Head of the Department concerneded by the end of the first semester.

9. EVALUATION OF STUDENTS' PERFORMANCE

9.1.Mid-semester examination (MSE)

9.1.1.Every teacher handling a subject shall conduct Mid-Semester Examination (MSE) as per the scheme drawn by the Head of the Department concerned /PG coordinator, and evaluate.The answer scripts will be shown to the student after valuation, and returned to the course teacher. The Head of the Department will be responsible to ensure the distribution of answer papers to the students. The marks obtained by the students should be sent to the Controller of Examinations through the Head of the Department concerneded within fifteen working days.

9.1.2. Writing the mid-semester examination is a pre-requisite for writing the final theory and practical examinations. If a student does not appear for MSE, he/she is not eligible to appear for the final examinations. Such candidate has to reappear for the MSE as and when the respective examinations are conducted only after getting permission from the Dean, Faculty of Agriculture on payment of fee prescribed by the University.

9.1.3 The MSE marks will not be shown separately in the grade sheet but will be combined with the respective final theory and practical marks. MSE marks awarded in a course will be added to the supplementary examinations also.

9.1.4 The MSE marks will be furnished to the Head of the Department within 10 days after the conduct of MSE. If the student is not satisfied with the award of the marks, he/she shall appeal to the Dean, through Head of the Department within three working days after the announcement of marks. The appeal will be considered and the results reviewed by a Cell consisting of the Dean and the Head of the Department concerneded. The decision of the Review Cell shall be final. If the Head of the Department himself is the course teacher, one senior member of the department concerneded shall be nominated by the Dean.

9.1.5 The MSE of theory will be of one hour duration

9.1.6 If the student is not able to write the MSE due to deputation by the University, he/she may be permitted to take up missing MSE. Such examination should be completed ordinarily within 15 working days after the respective MSE.

9.1.7 A student who fails to attend a mid-semester examination due to unavoidable circumstances shall be permitted with prior approval of the Dean to take up missing examination of the particular course, on payment of fee prescribed by the University. Such tests should be completed ordinarily within 15 working days after the respective MSE.

The distribution of marks will be as indicated below.

Test	Subjects with Practical	Subjects without Practical	Subjects without Theory
MID-SEMESTER	20	30	30
FINAL THEORY	40	70	-
FINAL PRACTICAL	40	-	70
Total	100	100	100

The question paper model and distribution of marks for Mid Semester examinations are as follows.

Mid-semester examination

For Subjects with practicals (20 marks)

1. Objective Type	10 out of 12	(10 X 0.5)	5 Marks
2.Definitions/ Concepts	5 out of 7	(5 X 1)	5 Marks
3. Short Notes	2 out of 3	(2 X 2 ½)	5 Marks
4. Essay Type	1 out of 2	(1 X 5)	5 Marks

For Subjects without practicals (30 marks)

1. Objective Type	10 out of 12	(10 X 0.5)	5 Marks
2.Definitions/Concepts	5 out of 7	(5 X 1)	5 Marks
3. Short Notes	4 out of 5	(4 X 2 ½)	10 Marks
4. Essay Type	2 out of 3	(2 X 5)	10 Marks

9.2. Final examinations

9.2.1. The final theory and practical examinations will be of three hours duration each conducted separately by the University.

9.2.2. Theory examinations will be conducted before practical examinations.

9.2.3. The final theory and practical examinations will be evaluated by two examiners (one will be the course teacher and the other will be one among the senior faculty suggested by the head in consultation with the The Dean, Faculty of Agriculture)

9.2.4. The question papers for the final theory examinations will be set by the person selected from the approved panel of question paper setters .

The question paper model and distribution of marks for final theory examinations are as follows.

Final theory examination

For subjects with practical (40 marks)

1. Definitions	5 OUT OF 7	(5X1)	5 MARKS
2. Short Notes	5 OUT OF 7	(5X2)	10 MARKS
3. Essay Type	Either or type (one question from each unit)	(5X5)	25 MARKS

For subjects without practicals (70 marks)

1. Definitions	5 OUT OF 7	(5X2)	10 MARKS
2. Short Notes	5 OUT OF 7	(5X4)	20 MARKS
3. Essay Type	EITHER OR TYPE (ONE QUESTION FROM EACH UNIT)	(5X8)	40 MARKS

9.2.5. Practical Examination

Practical examinations will be conducted separately towards the end of each semester. Proper maintenance and regular submission of practical records are required. Those who do not bring with them the certified practical records/specimen collection/assignments will not be allowed to appear for the practical examination. The marks awarded for specimen collection and assignments shall be noted in the record, at the time of first appearance and will be taken into account for subsequent appearances.

The distribution of marks for final practical examination for courses with theory and practical and only practical is as follows

S.No.	Particulars	Courses with theory and practical	Courses only with practical
1	**Practical part**	**25**	**55**
2	**Assignment/specimen collection**	**5**	**5**
3	**Record**	**5**	**5**
4	*Viva voce*	**5**	**5**
	Total	**40**	**70**

The pattern of practical part should be uniform in each Department

9.3. GRADING

- **The student should secure 60 per cent marks separately in theory and practical and 65 per cent marks in aggregate to secure a pass in the subject. Students who secure marks below 65 per cent in a subject will be treated as Reappearence (RA).**
- **Each subject shall carry a maximum of 100 marks for purpose of grading. The grading shall be done as grade point, i.e., the percentage of marks earned in a subject is divided by ten. The grade point is expressed on a10 point scale up to two decimals.**
- **The reappearance examinations for the candidates who fail in a subject or subjects will be held in the subsequent semester.**
- **Students who did not fulfill the required minimum attendance of 80 per cent will be awarded 'E' grade and has to repeat the subject.**

9.4. Class ranking

In calculation of class equivalent for OGPA the following classification shall be adopted.

OGPA	Class
9.00 and above	- Distinction
8.00 to 8.99	- I Class
7.00 to 7.99	- II Class
6.50 to 6.99	- Pass

9.5. Non- Credit Compulsory Subjects

For Non–Credit Compulsory subjects the evaluation processes will be as that of the regular subjects, however, the marks obtained will not be taken into account to calculate the OGPA.

10. Credit Seminar

Seminar is compulsory for all the students and each student should present a seminar of 0+1 credit in the third semester.

10.1 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 Chairman of the Advisory Committee in consultation with the Head of the Department concerneded within 2 weeks after the commencement of the semester.

10.2. Under the guidance and supervision of the Chairman of the Advisory Committee, the student will prepare the seminar paper after reviewing all the available literature and present the seminar 2 weeks after completion of Mid-Semester Examination in the presence of the Head of the Department, Advisory Committee, staff members and PG students.

10.3. The circular on the seminars by the post-graduate students shall be sent to other Departments to enable those interested to attend the same.

10.4. The Chairman will monitor the progress of the preparation of the seminar paper and correct the manuscript containing not less than 25 typed/printed pages with a minimum number of 50 references covering the recent 10 years time. The student will submit 2 copies of the corrected manuscript to the Head of the Department concerneded through the Chairman before presentation.

The student will incorporate suggestions and carry out corrections made during the presentation and resubmit three fair copies to the Head of the Department concerneded through the Chairman (one copy each to Dept. Library, Chairman and the student) within 10 days after presentation.

10.5 The performance of the student has to be evaluated for 100 marks and Grade Point will be awarded by the Head of the Department concerneded along with Advisory Committee. The Grade Point may be given based on the following norms.

Coverage of Literature	**40**
Presentation	**30**
Use of Audio–Visual Aids	**10**
Capacity to Participate in the discussion and answer the Questions	**20**
Total	**100**

11. Term paper / Special assignment

This has to be assigned to the student by the teacher in subject with theory and practical. Term papers should cover a wide range of topics within the subject limits. The topic should be different from that of the credit seminar. Term papers / special assignments will be evaluated during practical examination.

12. QUALIFYING EXAMINATION

Only those students who successfully completed the qualifying examination will be admitted to candidacy of the degree. The qualifying examination consists of written and oral examination.

12.1. Minimum requirement for Qualifying Examination

The students who have passed major courses will be permitted to appear for the qualifying examination. The qualifying examination will be conducted during IIIrd semester after midsemester examination and before the end of the IIIrd semester.

12.2. Selection of Examiner

A panel of five external examiners for qualifying examinations shall be given by the HOD at the end of II semester to the Controller of Examinations, who will nominate as per need from the panel of the examiner.

12.3. Written Examination

The written examination consists of one paper covering major subjects only.The Controller of Examination will conduct the examination by getting the question paper from external. The external examiner will evaluate the answer papers during his visit to conduct the viva-voce examination.

The question paper for the written examination will be of 3 hours duration and each question (Essay type) need not be restricted to any particular topic in a course but it should be comprehensive, The written examination will be conducted at the same time in all discipline.Qualifying marks for passing the written examination will be 60.

12.4. Qualifying viva-voce Examination

The advisory committee shall conduct the qualifying viva-voce examination with the external member, who shall be a specialist in the subject from outside the university

12.5. The Heads of departments will monitor and coordinate the conduct of the qualifying viva.The performance of the candidate will be Graded as Satisfactory / Unsatisfactory.

12.6. Communication of results of qualifying examination

The chairman of the advisory committee shall act as chairman for the examination committee and shall be responsible for communicating the results of the examination to the Controller of Examination through HOD in the prescribed format.

12.7. Failure /Absence in Qualifying Examination

When a student fails or absents for the qualifying examination, he/she may apply again for permission to appear for re-examination to the Controller of

Examination with the recommendation of the chairman of the advisory committee and Head of the Department. A student, who apply for re-examination should attend written examination and viva-voce. Re-examination shall not take place earlier than three months after the first examination and it will be conducted by the advisory committee as previously indicated. If a student fails in the re-examination, further re-examination will be considered on the recommendation of the Advisory Committee, HOD and Dean, Faculty of Agriculture. If the students fail in the qualifying examination, the research credits registered in the III semester should not be evaluated unless he / she successfully completes the qualifying examination.

12.8 Absence of advisory committee member during qualifying/final viva-voce examination:

1. **Conducting qualifying and final viva voce examination in the absence of advisory committee members is not allowed.**
2. **Under extra-ordinary circumstances if the qualifying/final viva-voce examination to postgraduate student has to be conducted in the absence of one or two advisory committee members, permission to conduct the examination by co-opting another member in such contingencies should be obtained from the Dean in advance through the Head of the Department. The Chairman of the advisory committee in consultation with the concerneded member and Head of the Department will co-opt another member.**
3. **The co-opted member should be from the same department of the member who is not attending the examinations.**
4. **In the absence of the Chairman of advisory committee, respective Heads of Departments should act as Co-chairman with prior permission of Dean.**

13. Research Work

13.1. The topic of thesis research to be carried out by the student will be assigned by the Chairman of the Advisory Committee in consultation with the Head of the Department concerneded. After assigning the topic, each student may be instructed 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 programme may be given to the student for carrying out the work during the semester in the prescribed proforma. The evaluation of research work done by the student should be based on the approved programme.

13.2. The distribution of research credits will be as follows:

I Semester	**0+ 1**
II Semester	**0+ 2**
III Semester	**0+ 8**
IV Semester	**0+ 9**
Total	**0 + 20**

14. Evaluation of Thesis Research

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

14.2. The student has to submit his/her research observation note book to the major Adviser.The major Adviser 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.

14.3. After completion of 80% attendance for research and on or before the last day of the semester, the advisory committee should evaluate the progress of research work as per the approved programme and monitoring register and award SATISFACTORY OR UNSATISFACTORY depending upon quantity and quality of work done by the student during the semester.

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

Situation - I

The students has completed the research credits as per the approved program and awarded 'SATISFACTORY' by the advisory committee. Under the said situation the student can be permitted to register fresh credits in the subsequent semester. If the student is awarded 'UNSATISFACTORY' he/she has to register afresh the same block of the research credits in the subsequent semester.

Situation - II

The student who does not satisfy the required 80 per cent attendance shall be awarded grade 'E'.

Situation-III

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

- **Failure of crop**
- **Non-Incidence of pests or diseases or lack of such experimental conditions**
- **Non-availability of treatment materials like planting materials chemicals etc.**
- **Any other impeding/ unfavourable situation for satisfying the advisory committee**
- **Under the situations (II&III) grade 'E' should be awarded. The student has to re-register the same block of research credits for which 'E' grade was awarded in the following semester. The student should not be allowed to register for fresh (first time) research credits.**
- **In the mark sheet, it should be mentioned that 'E' grade was awarded due to lack of attendance or want for favourable conditions.**

Situation – IV

The student who fails to complete the research work after repeating the registration for the second time will be awarded ' Unsatisfactory' and in the the mark sheet the 'second time' should be mentioned.

- **For the registration of research credits for the third time permission has to be obtained from the Dean of the Faculty and permission for further registration for the fourth time has to be obtained from the University.**
- **Re-registration of further research credits shall be decided by the University based on the recommendation of the Advisory Committee, Head of the Department concerneded and the Dean, Faculty of Agriculture.**

Situation-V

- **If a student could not complete qualifying examination till the end of the final semester/grace period, 'E' grade should be awarded for the final block of the research credits registered in the final semester. He/She has to re-register the same block of research credits in the next semester and attend the qualifying examination when conducted by the Controller of Examinations.**

15. Submission of Thesis

15.1. The thesis for his/her Master's degree should be of such a nature as to indicate a student's potentialities for conduct of independent research. The thesis shall be on topic falling within the field of the major subject and shall be the result of the student's own work. A certificate to this effect duly endorsed by the Major Adviser (Chairman) shall accompany the thesis.

15.2 The research credits registered in the last semester of post graduate programmes should be evaluated only at the time of the submission of thesis, by the advisory committee. Students can submit the thesis at the end of the final semester. If a post graduate student has completed the thesis before the closure of the final semester, the chairman can convene the advisory committee meeting and take decision on the submission of thesis provided the student satisfies 80 per cent attendance requirement. Two copies of the thesis should be submitted in paper pack for evaluation to the HOD.

16. Grace period

16.1 **Students can avail a grace period up to a month for submission of thesis/project report after the closure of final semester by paying necessary fine as prescribed by the University. If a student is not able to submit the thesis within a month grace period, the student has to re-register the credits in the forth coming semester.The student (s) who re-register the credits after availing the grace period will not be permitted to avail grace period.**

16.2 **Based on the recommendation of advisory committee and the Head of the Department, the Dean, can sanction the grace period. A copy of the permission letter along with the receipt for payment of fine as prescribed by the University should accompany the thesis while submission.**

17. Submission of thesis after re-registration

The minimum of 80 per cent 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 i.e. 2 years (4 semesters) and completed the minimum credit requirements for getting Degree.

18. Publication of articles

Part of the thesis may also be published in advance with the permission of the HOD. If any part is published the fact should be indicated in the certificate given by the chairman that the work has been published in part/full in the scientific or popular journals, proceedings, etc. The copies are to be enclosed in the thesis at the time of submission.

19. Evaluation of Thesis

19.1 **The thesis submitted in partial fulfillment of a Master's degree shall be evaluated by an external examiner. The external examiner shall be a specialist in the student's major field of study from outside Annamalai University and shall be appointed by the University as per the recommendation of the Head of the Department.**

19.2 **The external examiner will send the evaluation report in duplicate one marked to the Controller of Examination and another to the Head of the Department along with the corrected copy of the thesis. If the report is favourable, Viva-Voce will be arranged by the Head of the Department concerneded and conducted by the Advisory Committee. The chairman of the advisory committee shall send the recommendations of the examining committee to the Controller of Examinations through Head of the Department after the student duly carries out the corrections/ suggestions mentioned by the external examiner (a certificate to be enclosed along with the recommendation). On the unanimous recommendation of the committee and with the approval of the University, the degree shall be awarded to the candidate.**

19.3 **In case of rejection of the thesis by the external examiner, the Controller of Examinations may on the recommendation of the Head of the Department concerneded and Advisory Committee refer the thesis for valuation by a second external examiner chosen by the University. If the second external examiner recommends the thesis for acceptance, Viva-Voce will be conducted.**

19.4 **If the revision of the thesis is recommended for repeating experiments, field trial etc., resubmission must be done by the candidate concerned after a minimum of six months. The revised version should be sent to the examiner who recommended revision.**

19.5 **After incorporating the suggestions of the examiners and those received at the time of viva-voce, two hard bound copies of thesis should be submitted to the Department (one to the scholar and one to the chairperson) and two soft copies in CDs to the University. At the time of final submission, the advisory committee members should certify the corrections and suggestions carried out as indicated by the examiners. However, fellowship holder has to submit a hard bound copy also as per the need, 3 copies of abstract of thesis (in 10-15 lines), 2**

copies of the summary of the findings both in Tamil and English and also in C.D. form.

20. Revision of thesis

If an examiner recommends for revision of thesis the following norms will be adopted.

20.1 For revision of draft, the thesis should be resubmitted after a minimum of one month from the date of communication from the controller of examination

20.2 At the time of submission, the advisory committee should give certificate for carrying out the corrections/recommendations. The resubmitted copies of thesis should be got corrected carrying out the necessary corrections indicated by the external examiner and necessary certificates obtained from the chairman and HOD before the conduct of the final viva-voce.

20.3 A fine prescribed by the University to be collected from the students at the time of resubmission of thesis.

21. Failure to appear for final Viva-voce/ Non submission of thesis after viva-voce.

21.1 If a candidate fails to appear before the examining committee for final viva-voce, on the date fixed by the HOD the following are the time frame and penalty.

21.2 The re-viva-voce must be completed within two years. An amount of fine prescribed by the University must be charged to the candidate.

21.3 After successful completion of thesis final viva-voce if a student fails to submit the corrected version of the thesis within 15 days he/she will be levied a fine prescribed by the University at the time of sending the proposal for result declaration

22. Result notification

22.1 After the completion of each semester, the student will be given the statement of marks by the Controller of Examinations

22.2 The transcript will be prepared by controller of examinations. The various subjects taken by a student along with the credits and the grade obtained shall be shown on his transcript. Based on the total credits admitted, the final Grade Point Average shall be calculated and given.

23. Award of Medals

Medal should be awarded only if the student secures at least 8.0 OGPA, clears all courses in first attempt and in the programme having a batch of at least three students.

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DEPARTMENT OF HORTICULTURE
GHOR 21 M.Sc. (HORTICULTURE) IN FRUIT SCIENCE

Programme Outcome:

Any post graduate from the Faculty of Agriculture will

PO1. have core knowledge leading to awareness on advancements in the field of agriculture and horticulture including crop production, soil fertility, crop protection, crop improvement, microbiology, bio technology, agricultural extension and economics.

PO2. have basic understanding and skill on experimental tools in biological sciences, analytical techniques for plant and soil samples, microbial technologies, biotechnological tools, breeding methods, statistical tools & analysis, research data computation, etc, required for higher learning, research and development.

PO3. be mastering the modern agronomic techniques of crop production, water, soil & nutrient management, plant protection with respect to insect pest and plant diseases , crop improvement and ecosystem restoration.

PO4. will be able to design and execute individual research project, write concise & persuasive research articles and communicate effectively with their scientific colleagues, farmers and the general public.

PO5. be able to communicate research and educational materials properly and competently and

PO6. be able to address complex problems taking into account related ethical, social, legal, economic, and environmental issues.

Programme Specific Outcome:

The student will be able to

PSO1- acquire knowledge on crop improvement, production technologies, and post harvest technologies pertaining to Fruit crop.

PSO2- recommend suitable package of practices to various stake holders.

PSO3- carryout individual research works in Fruit crops and writing reports.

PSO4- become eligible to work in commercial horticultural units, research projects, post harvest industries, etc.

GHOR 21 M.Sc. (HORTICULTURE) IN FRUIT SCIENCE

DISTRIBUTION OF COURSES

S. No.	Course Code	Course Title	Credit Hours
		Major courses	
1.	FSC 611	Breeding of fruit crops	2+1
2.	FSC 612	Tropical and dryland fruit production	2+1
3.	FSC 613	Biodiversity and conservation of fruit crops	2+1
4.	HOR 621 HOR 622	Growth regulation and stress management in horticultural crops (or) Protected and precision horticulture	2+1
5.	FSC 621	Subtropical and temperate fruit production	2+1
6.	FSC 622 FSC 623	Biotechnology of fruit crops (or) Organic fruit production	1+1
7.	FSC 624	Post harvest technology of fruit crops	2+1
			13+7=20
	FSC 011/021/031/041	Research(0+1)+(0+2)+(0+8)+(0+9)	0+20
	FSC 032	Seminar	0+1
		Minor courses	
1.	OPC-GPB 621	Concepts of crop physiology	2+1
2.	OPC-XXX	Minor course from other departments /related disciplines	2+1
3.	OPC-XXX	Minor course from other departments /related disciplines	2+1
			6+3=9
		Supporting courses	
1.	STA 611	Statistical methods and design of experiments	2+1
2.	COM 611	Computer applications for agricultural research	1+1
			3+2=5
		Non - credit compulsory courses	
1.	PGS 611	Agricultural research ethics and methodology	0+1
2.	PGS 612	Technical writing and communication skills	0+1
3.	PGS 623	Basic concepts in laboratory techniques	0+1
4.	PGS 624	Library and information services	0+1
5.	PGS 715*	Intellectual property rights and its management in agriculture	1+0
6.	PGS 716*	Disaster management	1+0
7.		Value added course	3+0
8.		Value added course	3+0
			8+4=12

*** e-course**

GHOR 21 M.Sc. (HORTICULTURE) IN FRUIT SCIENCE

SEMESTER WISE DISTRIBUTION OF COURSES

SEMESTER I			
S. No.	**Course Code**	**Course Title**	**Credit Hours**
1.	FSC 611	Breeding of fruit crops	2+1
2.	FSC 612	Tropical and dryland fruit production	2+1
3.	FSC 613	Biodiversity and conservation of fruit crops	2+1
4.	STA 611	Statistical methods and design of experiments	2+1
5.	COM 611	Computer applications for agricultural research	1+1
6.	FSC 011	Research	0+1
7.	PGS 611	Agricultural research ethics and methodology *	0+1
8.	PGS 612	Technical writing and communication skills *	0+1

SEMESTER-II			
1.	HOR 621 HOR 622	Growth regulation and stress management in horticultural crops (or) Protected and precision horticulture	2+1
2.	FSC 621	Subtropical and temperate fruit production	2+1
3.	FSC 622 FSC 623	Biotechnology of fruit crops (or) Organic fruit production	1+1
4.	FSC 624	Post harvest technology of fruit crops	2+1
5.	OPC-GPB 621	Concepts of crop physiology	2+1
6.	FSC 021	Research	0+2
7.	PGS 623	Basic concepts in laboratory techniques*	0+1
8.	PGS 624	Library and information services *	0+1

Semester-III			
S. No.	**Course Code**	**Course Title**	**Credit Hours**
1.	OPC-XXX	Minor course from other departments /related disciplines	2+1
2.	OPC-XXX	Minor course from other departments /related disciplines	2+1
	OPC-HOR 711#	Propagation and nursery management of horticultural crops	2+1
	OPC-FSC 712#	Genetic resources and conservation of fruit crops	2+1
3.	FSC 031	Research	0+8
4.	FSC 032	Seminar	0+1
5.	PGS 715	Intellectual property rights and its management in agriculture *	1+0
6.	PGS 716	Disaster management *	1+0
7.	PGS 717	Constitution of India*	1+0

Semester-IV			
1.	FSC 041	Research	0+9
2.	VASC	Value added course *	3+0

#-Optional course offered to other departments/discipline only
***Non – credit compulsory course**

ABSTRACT

Course	Semester wise credit distribution				Total
	I	II	III	IV	
Major	9	11	-	-	20
Minor	-	3	6	-	9
Supporting	5	-	-	-	5
Seminar	-	-	1	-	1
Research	1	2	8	9	20
Total credits	15	16	15	9	55
Non-credit	Two courses	Two courses	Three courses	One Course	Eight courses

FSC 611 BREEDING OF FRUIT CROPS (2+1)

Learning Objectives

- **To impart comprehensive knowledge about different methods of breeding techniques employed in fruit crops.**
- **To provide an insight on the achievements made so far and problems encountered in the breeding of fruit crops.**

Theory

Origin and distribution- taxonomical status, species and cultivars, cytogenetics, genetic resources- blossom biology- genetic resources- breeding objectives- breeding systems- ideotypes- approaches for crop improvement- introduction-selection- hybridization-mutation breeding- polyploidy breeding- rootstock breeding- improvement of quality traits- resistance breeding for biotic and abiotic stresses- biotechnological interventions- achievements and future thrust in the following selected fruit crops.

Unit I Breeding of tropical fruit crops - I

Mango, banana and papaya

Unit II Breeding of tropical fruit crops -II

Guava, sapota and grapes

Unit III Breeding of sub-tropical fruit crops -I

Citrus, pineapple, jack fruit and avocado

Unit IV Breeding of sub- tropical fruit crops -II

Litchi, annona, ber and pomegranate

Unit V Breeding of temperate fruit crops

Apple, pear, plum, peach, apricot and strawberry

Current Stream of Thought

Practical

Characterization of germplasm- blossom biology- estimating fertility status- practices in hybridization- ploidy breeding- mutation breeding- evaluation based on biometrical traits and quality traits- screening for resistance against biotic and abiotic stress- developing breeding programme for specific traits- visit to research stations working on tropical- subtropical and temperate fruit improvement.

Lecture schedule

1. Need and status of fruit breeding in India, study of institutes working on fruit crop improvement

2. Constraints of breeding of fruit crops, sterility, incompatibility, heterozygosity and methods suggested to overcome the hurdles in breeding

3. Scope for breeding against production constraints , yield and quality enhancement

4. Pollination problems in relevance to fruit set in the given fruit crops.

Origin and distribution, taxonomic status, related genus, species and cultivars, ideotypes, cytogenetics, genetic resources for improvement, breeding objectives, breeding systems- introduction, selection, hybridization, mutation breeding, polyploidy breeding, rootstock breeding, quality and resistance breeding, biotechnological interventions, achievements and future thrust for the following crops:

5-6.Mango

7-8. Banana

9-10. Papaya

11-12.Guava

13-14. Citrus

15-16. Grapes

17. Mid-semester examination

18. Sapota

19. Pineapple

20. Jack

21 Avocado

22. Litchi

23. Annona

24. Ber

25. Pomegranate
26-27. Apple
28. Pear
29. Plum
30. Peach
31. Apricot
32. Strawberry
33 Walnut
34. Almond

Practical schedule

1. **Scoring techniques for genomic status in banana.**
2. **Characterization of germplasm of banana.**
3. **Characterization of germplasm of papaya.**
4. **Study of blossom biology in mango, banana and papaya.**
5. **Study of blossom biology of guava, sapota, grapes.**
6. **Study of blossom biology of mandarin, pineapple, jackfruit, avocado and litchi.**
7. **Study of blossom biology of apple, pear, plum, peach, apricot and strawberry.**
8. **Estimation of pollen output, viability and germinability in fruit crops.**
9. **Practices in hybridization, ploidy breeding, mutation breeding of mango and banana.**
10. **Practices in hybridization, ploidy breeding, mutation breeding of papaya and sapota.**
11. **Practices in hybridization, ploidy breeding, mutation breeding of grapes and guava.**
12. **Criteria for evaluation based on biometric and quality traits in fruit crops.**
13. **Screening and scoring techniques for resistance against biotic stress such as viral diseases and fusarium wilt in banana and PRSV in papaya.**
14. **Screening techniques for resistance against abiotic stresses like salt and drought tolerance in fruit crops.**
15. **17. Visit to research institutes working on improvement of fruit crops and visit to sub- tropical research stations for studying breeding programmes.**

Course Outcome

CO1- Students will be able to understand the different breeding methods followed in fruit crops.

CO2- They will be able to demonstrate and carry out different techniques employed in breeding of fruit crops.

CO - PSO - PO Mapping

	PSO1	PSO2	PSO3	PSO4	PO1	PO2	PO3	PO4	PO5	PO6
CO1	X		X	X		X		X	X	X
CO2	X		X	X		X		X	X	X

References

1. **Bose, T.K., S.K. Mitra and D. Sanyol. (Eds.). 2002. Fruits of India – Tropical and Sub-tropical. 3rd Ed. Vols. I, II. Naya Udyog, Kolkatta**
2. **Chadha, K.L. and O.P. Pareek. (Eds.). 1996. Advances in Horticulture. Vol. I.Malhotra Publ. House., New Delhi.**
3. **Chadha, K.L. and S.D. Shikhamany.1999. The Grape: Improvement, Production and Post-Harvest Management. Malhotra Publ. House, New Delhi**
4. **Janick, J. and J.N. Moore. 1996. Fruit Breeding. Vols.I-III. John Wiley and Sons,USA.**
5. **Nijjar, G.S. (Eds.).1977. Fruit Breeding in India. Oxford & IBH Publishing CO, New Delhi.**
6. **Radha, T. and L. Mathew. 2007. Fruit Crops. New India Publ. Agency.**
7. **Shukla, A.N. and Vashishtha. 2004. Fruit Breeding: Approaches and Achievements. International Book Distributing Co., Lucknow, UP.**

FSC 612 TROPICAL AND DRY LAND FRUIT PRODUCTION (2+1)

Learning Objectives

- **To impart knowledge on the importance, scientific management practices and problems associated in the production of tropical and dry land fruit crops grown in India.**
- **To provide information on the postharvest management and marketing potential of tropical and dry land fruit crops prevalent in India.**

Theory

Commercial varieties of regional- national and international importance- eco-physiological requirements- recent trends in propagation- rootstock influence- cropping systems- planting systems- HDP- root zone and canopy management- nutrient management- water management- fertigation- role of bio regulators- abiotic factors limiting fruit production- physiology of flowering- pollination- fruit set and development- physiological disorders- causes and remedies- organic production technologies- quality improvement by management practices; maturity indices-harvesting- grading- packing- storage and ripening techniques- mechanisation in fruit production- industrial and export potential- agri-export zones (AEZ)- industrial supports and research advancements made in the following fruit crops.

Unit I Tropical fruit crops-I

Mango and banana

Unit II Tropical fruit crops-II

Citrus, sapota and guava

Unit III Tropical fruit crops -III

Papaya, jackfruit and pomegranate

Unit IV Arid zone fruit crops -I

Aonla, ber, jamun and annona

Unit V Arid zone fruit crops -II

Wood apple, bael, karonda, manila tamarind and phalsa

Current Stream of Thought

Practical

Identification of important cultivars- observations on growth and development-practices in growth regulation- malady diagnosis- analysis of quality attributes- visit to tropical and arid zone orchards- analyzing stress management practices- project preparation for establishing commercial orchards.

Lecture schedule

1. Scope and current status of area- production and export of tropical and dry land fruit crops in India- scope for cultivation and area expansion- industrial and export potential.

Commercial varieties of regional- national and international importance-ecophysiological requirements- recent trends in propagation- rootstock influence-planting systems- cropping systems- root zone and canopy management- nutrient management- water management- fertigation- role of bio-regulators- abiotic factors limiting fruit production- physiology of flowering- pollination- fruit set and development- honeybees in cross pollination- physiological disorders- causes and remedies- major biotic stresses and their management quality improvement by management practices- maturity indices- harvesting- grading- packing- storage and ripening techniques- mechanisation in fruit production- industrial and export potential- Agri. Export Zones (AEZ) and industrial supports for the following crops:

2-4. Mango.

5-7 . Banana

8-9. Sweet orange

10-11. Acid lime

12-13. Lemons

14. Sapota

15-16. Guava

17. Mid- semester examination
18-19. Papaya
20. Jack fruit
21-22. Pomegranate
23-24. Annona
25-26.Ber
27. Jamun
28-29. Aonla
30.Wood apple and bael
31. Karonda
32. Manila tamarind
33. Phalsa
34. Processing industries for tropical and arid zone fruit crops

Practical schedule

1. **Identification of important cultivars, observations on growth and development in mango.**
2. **Practices in growth regulation and malady diagnosis in mango.**
3. **Identification of important cultivars, observations on growth and development in banana.**
4. **Special practices, growth regulation and malady diagnosis in banana**
5. **Identification of important cultivars, observations on growth and development in citrus.**
6. **Practices in growth regulation and malady diagnosis in citrus.**
7. **Identification of important cultivars, observations on growth and development, practices in growth regulation, papain extraction and malady diagnosis in papaya.**
8. **Identification of important cultivars, observations on growth and development, growth regulation, and malady diagnosis in sapota.**
9. **Identification of important cultivars, observations on growth and development, practices in growth regulation and malady diagnosis in guava.**
10. **Identification of important cultivars, observations on growth and development, practices in growth regulation and malady diagnosis in pomegranate.**
11. **Identification of important cultivars, observations on growth and development, practices in growth regulation and malady diagnosis in jackfruit.**
12. **Analysis of quality attributes in fruit crops- TSS, acidity and ascorbic acid.**
13. **Analysis of quality attributes in fruit crops – sugars and carotenoids.**
14. **Project preparation for establishing commercial orchards.**
15. **16.Visit to commercial tropical orchards.**
17. **Visit to arid zone orchards.**

Course Outcome

CO1-Students will be able to appreciate the research advancements made in the Tropical and dry land fruit crops.

CO2-They will be able to recommend suitable package of practices for enhanced production of Tropical and dry land fruit crops.

CO - PSO - PO Mapping

	PSO1	PSO2	PSO3	PSO4	PO1	PO2	PO3	PO4	PO5	PO6
CO1	X	X	X	X	X	X	X	X	X	X
CO2	X	X	X	X	X	X	X	X	X	X

References

1. **Bose, T.K., S.K. Mitra. and D. Sanyal. (Eds.). 2001. Fruits – Tropical and Subtropical. Naya Udyog, Kolkatta.**
2. **Chanda, K.L. and O.P. Pareek. (Eds.).1996. Advances in Horticulture. Vols II to IV. Malhotra Publ. House, India.**
3. **Nakasone, H.Y. and R.E. Paul. 1998. Tropical Fruits. CABI. UK**
4. **Peter, K.V. 2008. Basics of Horticulture. New India Publ.Agency, New Delhi.**
5. **Pradeepkumar, T., B. Suma, Jyothibhaskar and K.N. Sathhesan. 2008. Mangement of Horticultural Crops. Parts I, II. New India Publ. Agency, New Delhi.**

6. Radha, T. and L. Mathew. 2007. Fruit Crops. New India Publ. Agency, New Delhi.
7. Singh, H.P., J.P. Negi and J.C. Samuel. (Eds.). 2002. Approaches for Sustainable Development of Horticulture. National Horticultural Board, India.
8. Singh, H.P., G. Singh, J.C. Samuel and R.K. Pathak. (Eds.). 2003. Precision Farming in Horticulture. NCPAH, DAC/PFDC, CISH, Lucknow.

FSC 613 BIODIVERSITY AND CONSERVATION OF FRUIT CROPS (2+1)

Learning Objectives

- To provide an insight on the principles of biodiversity, strategies in conservation and utilization of fruit crop biodiversity.
- To provide information about under exploited fruits in India.

Theory

Unit I Importance of biodiversity and methods of conservation

Biodiversity and conservation- issues and goals- centres of origin of cultivated fruits- primary and secondary centres of genetic diversity- present status of gene centres- exploration and collection of germplasm- conservation of genetic resources- *in situ* and *ex situ* germplasm conservation- problem of recalcitrancy- cold storage of scions- tissue culture- cryopreservation- pollen and seed storage- inventory of germplasm.

Unit II Role of National institutes in conservation and plant quarantine

Introduction of germplasm- plant quarantine- role of national institutes in conservation- TBGRI- NBPGR-etc- intellectual property rights- regulatory horticulture- plant variety protection authority- maintenance of core group using traditional knowledge for plant conservation.

Unit III Bio diversity of tropical fruit crops

Biodiversity of major tropical fruit crops - mango- banana- sweet orange- lime- lemon- sapota- papaya- guava- pomegranate- pineapple- annona and avocado.

Unit IV Bio diversity of sub tropical and temperate fruit crops

Biodiversity of major sub tropical- temperate fruit and nut crops - grapes- mandarin- mangosteen- litchi- fig- apple- pear- plum- peach- strawberry- almond- apricot and walnut.

Unit V Bio diversity of under exploited minor fruit crops

Under exploited minor fruits -present status and scope- their origin- distribution- biodiversity- conservation and utilization of minor fruits.

Current Stream of Thought

Practical

Documentation of germplasm- maintenance of passport data and other records of accessions- field exploration trips- exercise on *ex situ* conservation- cold storage- pollen/seed storage- cryopreservation- visits to national gene bank and other centres of PGR activities- core sampling- germplasm characterization using molecular techniques.

Lecture schedule

1. Bio diversity – introduction , principles, goals and issues in conservation.
2. Genetic diversity- occurrence and distribution.
3. Exploration, collection, characterization, documentation and cataloguing of germplasm.
4. Present status of national and international gene banks.
5. Role of national institutes in conservation-TBGRI, NBPGR.etc.
6. Germplasm exchange, Material Transfer Agreement and current quarantine protocols.
7. Methods for *ex situ* conservation of germplasm and *in situ* conservation of germplasm .
8. Use of GIS and documentation of local biodiversity.
9. Horticultural cropping systems and implication on biodiversity.
10. Impact of climate change on biodiversity.
11. Advances and issues in conservation of biodiversity though recalcitrant and orthodox seeds.

12. Advances and issues in conservation of biodiversity through vegetative propagation .
13. Intellectual Property Rights, Plant Variety Protection Authority.
14. Status of biodiversity of mango.
15. Status of biodiversity of banana.
16. Status of biodiversity of sweet orange, lime and lemon.
17. Mid-semester examination
18. Status of biodiversity of sapota and papaya.
19. Status of biodiversity of guava and pomegranate.
20. Status of biodiversity of pineapple and annona.
21. Status of biodiversity of avocado and mangosteen.
22. Status of biodiversity of grapes.
23. Status of biodiversity of mandarin.
24. Status of biodiversity of litchi and fig.
25. Status of biodiversity of apple and pear.
26. Status of biodiversity of plum and peach.
27. Status of biodiversity of strawberry .
28. Status of biodiversity of almond and apricot.
29. Status of biodiversity of walnut.
30. Under exploited minor fruit crops - present status and scope.
31-34.Minor fruits - origin, distribution - biodiversity, propagation, conservation and utilization.

Practical schedule

1. **Field exploration trips- exercise in collection and characterization.**
2. **Visit to field germplasm unit and documentation of germplasm.**
3. **Practices in maintenance of passport data.**
4. **Practical study of** *ex situ* **conservation methods.**
5. **Practical study of** *in situ* **conservation methods.**
6. **Methods of seed storage for short and long term conservation.**
7. **Methods of conservation using vegetative propagules.**
8. *In vitro* **conservation protocols.**
9. **Study of species diversity in horticultural cropping system.**
10. **Visit to regional conservation centres.**
11. **Visit to subtropical and temperate zone orchards.**
12. **Characterization of banana germplasm.**
13. **Characterization of papaya germplasm.**
14. **Characterization of mango germplasm.**
15. **Identification of minor fruit crops and their description.**
16. **Use of molecular tools for characterizing species diversity.**
17. **Estimating extent of diversity through collection and analysis of data.**

Course Outcome

CO1- The students will be able to understand the strategies in conservation and utilization of fruit crop biodiversity
CO2- They will be able to demonstrate different techniques in *ex -situ* **conservation.**
CO3 -They will be able to identify underutilized minor fruit crops.

CO - PSO - PO Mapping

	PSO1	PSO2	PSO3	PSO4	PO1	PO2	PO3	PO4	PO5	PO6
CO1	X		X			X		X	X	X
CO2	X		X			X		X	X	X
CO3	X		X			X		X	X	X

References

1. **Frankel, O.H and J.G. Hawkes. 1975. Crop Genetic Resources for Today and Tomorrow. Cambridge University Press.UK.**
2. **Peter, K.V and Z. Abraham. (Eds). 2007. Biodiversity in Horticultural Crops.Vol.1 Daya Publishers, New Delhi.**
3. **Peter, K.V. (Ed). 2008. Biodiversity in Horticultural Crops.Vol.2 Daya Publishers, New Delhi.**

4. Peter, K.V. (Ed). 2010. Biodiversity in Horticultural Crops.Vol.3 Daya Publishers, New Delhi.

FSC 621 SUBTROPICAL AND TEMPERATE FRUIT PRODUCTION (2+1)

Learning Objectives

- **To impart knowledge on the importance, scientific management practices and problems associated in the production of subtropical and temperate fruits grown in India.**
- **To provide information on the postharvest management and marketing potential of subtropical and temperate fruits prevalent in India.**

Theory

Commercial subtropical fruits and temperate fruits and nuts- eco physiological requirements- important varieties- latest propagation techniques followed- rootstocks- stock/scion relationships- planting systems- hdp- cropping systems- root zone and canopy management- modern irrigation and nutrient management- factors (abiotic and biotic) limiting fruit production and their management- gap- physiology of flowering and fruit set and development- off season and year round production- management practices for quality improvement- organic production technologies- maturity indices- harvesting- grading- packing- pre- cooling- storage- transportation and ripening techniques- mechanisation in fruit crops- local and export market potential- AEZs and industrial support- research advances made in the following fruit crops:

Unit I Sub tropical fruit production -I

Hill banana, grapes, mandarin and pineapple

Unit II Sub tropical fruit production -II

Mangosteen, durian, passion fruit, fig and avocado

Unit III Sub tropical fruit production -III

Persimmon, loquat, litchi, rambutan, carambola and bilimbi

Unit IV Temperate fruit crop production

Apple, pear, plum, peach, strawberry

Unit V Nut crop production

Kiwi, apricot, walnut, almond, pistachio, pecan and hazelnut.

Current Stream of Thought

Practical

Identification of important cultivars- designing hdp system for optimum production- growth regulation and off season production using pruning methods and use of growth regulators - diagnosis and correction of physiological disorders- identification of nutrient and micronutrient deficiencies and their correction- identification of storage disorders and following preventive methods- visit to subtropical and temperate orchards and fruit processing and package industries- project preparation for establishing commercial orchards.

Lecture schedule

1.Importance- area and production of subtropical and temperate fruit crops in Tamilnadu and India.

Important varieties- latest propagation techniques followed- rootstocks- stock/scion relationships- modern hdp systems for tropical and subtropical fruit crops- pruning methods and machineries used in HDP and off season production- growth regulation using growth regulators for off-season fruit production- good agricultural practices- mechanisation in fruit crops local and export market potential for the following subtropical and temperate fruit crops:

2. Hill banana

3-5. Grapes

6. Mandarin

7-8.Pineapple

9. Mangosteen

10. Durian

11.Passion fruit and Kokam

12 .Fig
13. Avocado
14. Persimmon
15. Loquat
16. Litchi
17. Mid-semester examination
18. Rambutan
19. Carambola and Bilimbi
20. Unique climatic requirements for temperate fruit crops
21-22. Apple
23. Pear
24. Plum
25. Peach
26. Strawberry
27. Apricot
28. Cherries
29. Kiwi fruit
30. Commercial temperate nuts and their economic importance
31. Walnut
32. Almond
33. Pistachio, pecan and hazelnut
34. Processing industries for subtropical and temperate fruit crops

Practical schedule

1. **Description of commercial subtropical fruits.**
2. **Propagation techniques for subtropical fruits.**
3. **Designing HDP for subtropical fruits.**
4. **Pruning and growth regulation of grapes for year round production.**
5. **Preparation of growth regulator solutions for propagation and flower induction in subtropical fruits.**
6. **Visit to grape gardens.**
7. **Identification of nutrient and physiological disorders in citrus sp.**
8. **Preparation of micronutrient mixtures for alleviating nutrient deficiency of citrus.**
9. **Visit to temperate orchards – HRS, Kodaikanal and study of mandarin at HRS Thadiyankudisai, identification of important cultivars and survey of existing cropping systems.**
10. **Visit to cold storage unit - study of stored temperate fruits for quality and diseases.**
11. **Development of a model fruit cropping system suitable for southern (Tamilnadu) subtropical areas.**
12. **Development of a model fruit cropping system for southern (Tamilnadu) temperate areas**
13. **Nutrition management in subtropical fruits.**
14. **Nutrition management in temperate fruits.**
15. **Identification of maturity indices for subtropical and temperate fruit crops.**
16. **Project Preparation for commercial orchard establishment.**
17. **Visit to Kallar and Burliar State Horticultural Farms .**

Course Outcome

CO1-Students will be able to appreciate the research advancements made in the Subtropical and Temperate fruit crops.

CO2-They will be able to recommend suitable package of practices for enhanced production of Subtropical and Temperate fruit crops.

CO - PSO - PO Mapping

	PSO1	PSO2	PSO3	PSO4	PO1	PO2	PO3	PO4	PO5	PO6
CO1	X	X	X	X	X	X	X	X	X	X
CO2	X	X	X	X	X	X	X	X	X	X

References

1. **Bose, T.K., S.K. Mitra. and D.S. Rathore. (Eds.). 1988. Temperate Fruits - Horticulture.Allied Publ.New Delhi.**
2. **Bose, T.K., S.K. Mitra. and D. Sanyal. (Eds.). 2001. Fruits -Tropical and Subtropical. Naya Udyog, Kolkatta.**
3. **Chadha, K. L. and O.P. Pareek. (Eds.). 1996. Advances in Horticulture. Vols. III-V. Malhotra Publ. House, India**
4. **Nakasone, H. Y. and R.E. Paul. 1998. Tropical Fruits. CAB International, Wallingford, England.**
5. **Peter, K.V. (Ed.). 2008. Basics of Horticulture. New India Publ. Agency, New Delhi.**
6. **Pradeepkumar, T., B. Suma., Jyothibhaskar and K.N. Satheesan. 2008.: Management of Horticultural Crops (2 Parts-Set), In: Horticulture Science Series : Vol: XI (K.V.Peter (Ed.)). New India Publ.Agency, New Delhi.**
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FSC 622 BIOTECHNOLOGY OF FRUIT CROPS (1+1)

Learning Objectives

- **To comprehend the principles of biotechnology.**
- **To learn about the various developments in biotechnology and its potential applications.**
- **To impart knowledge and practical skills to use biotechnological tools in fruit crops**

Theory

Unit I Importance of biotechnology and factors affecting tissue cultures

Harnessing biotechnology in fruit crops- influence of plant materials- physical-chemical factors and growth regulators on growth and development of plant cell- tissue and organ cultures.

Unit II Techniques in biotechnology -I

Callus culture- types- cell division- differentiation- organogenesis- embryogenesis- organ culture- meristem- embryo- endosperm-anther- ovule culture- embryo rescue- rapid clonal propagation- somaclonal variations.

Unit III Techniques in biotechnology-II

Hardening and field transfer- use of bioreactors and *in vitro* **methods for production of secondary metabolites- suspension cultures- regeneration of tissues.**

Unit IV Techniques in biotechnology -III

Protoplast culture and fusion- construction and identification of somatic hybrids and cybrids- *in vitro* **pollination and fertilization-** *in vitro* **mutation- artificial seeds.**

Unit V Techniques in biotechnology -IV

Cryopreservation- genetic engineering in horticulture crops- use of molecular markers- i*n vitro* **selection for biotic and abiotic stress- achievements of biotechnology in fruit crops.**

Current Stream of Thought

Practical

An exposure to tissue culture laboratories- media preparation- inoculation of explants for clonal propagation- callus induction and culture- regeneration of plantlets from callus- sub-culturing- techniques on anther- embryo culture- somaclonal variation- *in vitro* **mutant selection against abiotic stress- development of protocols for mass multiplication- project development for establishment of commercial tissue culture laboratory.**

Lecture schedule

1. **Role of biotechnology in fruit crops.**
2. **Influence of plant materials, physical and chemical factors on growth and development of plant cell tissues and organs.**
3. **Callus cultures, differentiation, organogenesis and somatic organogenesis.**
4. **Meristem culture for disease elimination.**
5. **Production of haploids and dihaploids through anther, pollen and ovule culture.**
6. **Embryo culture and endosperm culture techniques**
7. **Rapid** *in vitro* **clonal propagation through direct organogenesis.**
8. **Hardening and establishment of tissue cultured plantlets in primary, secondary nursery and field.**
9. **Mid – semester examination**
10. **Somaclonal variations and its applications.**
11. *In vitro* **production of secondary metabolites**
12. **Protoplast culture and regeneration and protoplast fusion.**
13. **Techniques of** *in vitro* **pollination and fertilization and** *in-vitro* **mutation**
14. **Synthetic seed production techniques**
15. *In vitro* **conservation and cryopreservation techniques.**
16. **Genetic engineering and transgenics.**
17. **Vectors and methods of transformation.**

Practical schedule

1. **Components of tissue culture laboratory.**
2. **Laboratory equipments-uses and methods of operation.**
3. **Nutrient stock and growth regulator stock preparation.**
4. **Culture media preparation.**
5. **Sterilization techniques for glassware and media.**
6. **Inoculation of explants for direct organogenesis.**
7. **Inoculation of explants for callus culture.**
8. **Clonal propagation through meristem culture.**
9. **Anther, pollen and ovule culture.**
10. **Sub-culturing techniques for regeneration.**
11. **Induction of multiple shoots and roots.**
12. *In vitro* **screening of cell lines for abiotic stress.**
13. *In vitro* **mutation for abiotic stress.**
14. **Synthetic seed production.**
15. **Hardening techniques.**
16. **Visit to leading commercial tissue culture units.**
17. **Project preparation for establishment of tissue culture labs.**

CourseOutcome

CO1: The students will be able to demonstrate different techniques in biotechnology.
CO2: They will be able to prepare a proposal for establishment of a tissue culture laboratory.

CO - PSO - PO Mapping

	PSO1	PSO2	PSO3	PSO4	PO1	PO2	PO3	PO4	PO5	PO6
CO1	X		X	X	X	X		X	X	X
CO2	X		X	X	X	X		X	X	X

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FSC 623 ORGANIC FRUIT PRODUCTION (1+1)

Learning Objectives

- To educate the students on the principles and concepts of organic farming in the production of fruit crops.
- To appraise about the methods of sustainable organic farming in fruit crops.

Theory

Unit I Importance of organic Horticulture

Organic Horticulture definition – synonyms and misnomers – principles – methods – merits and demerits – present status- rationale back ground of organic fruit production in India and in the world.

Unit II Bio inputs in organic Horticulture

Different organic inputs – their role in organic fruit production – bulky organic manures – green manures – bio fertilizers – bio dynamics – em technology and its impact in organic fruit production

Unit III Biological management in organic Horticulture

Indigenous practices in organic horticulture – sustainable soil fertility management – weed management practices in organic fruit production- biological/natural control of pests and diseases- quality improvement

Unit IV Certification in organic Horticulture

GAP- Principles and management – HACCP exercise – certification of organic products and systems – agencies involved at National and International level – standards evolved by different agencies.

Unit V Post harvest management and sustainability in organic Horticulture

Constraints in certification – organic fruit production and export – IFOAM and global scenario of organic movement – post harvest management of organic fruit produce -sustainability and input management system in organic fruit production.

Current Stream of Thought

Practical

Estimation of soil physical, chemical and biological parameters – composting of farm wastes and agro industrial wastes -recycling of crop wastes through vermiculture- preparation of panchakavya -activated em solution nutritive analysis for estimating the potential of organics- mulching -nursery bed soil solarisation- bio agents for crop protection and their preparation-working out indices for organic fruit production- economic evaluation of organic fruit production system -visit to farmers field under organic fruit production .

Lecture schedule

1. Organic horticulture, definition, synonyms and misnomers.
2. Scope, principles of organic horticulture and merits and demerits.
3. Present status, rationale and back ground of organic fruit production in India and the world.
4. Different organic inputs and its role in organic fruit production.
5. Bulky organic green manures and biofertilizers.
6. Biodynamic farming, EM technology and its impact.
7. Indigenous practices in organic horticulture.
8. Sustainable soil fertility management.
9. Mid – semester examination
10. Weed management practices in organic fruit production.

11. **Biological/natural pest management.**
12. **Biological/natural disease management with respect to quality.**
13. **GAP principles and management.**
14. **Certification of organic produce and agencies at national and international levels.**
15. **Standards for different agencies .**
16. **Constraints in certification.**
17. **Post harvest management of organic produce and sustainability and input management.**

Practical schedule

1. **Soil physical parameters with relevance to organic fruit production.**
2. **Estimate of soil chemical parameters (pH, EC and ESP).**
3. **Estimation of soil biological parameters.**
4. **Estimation of farm wastes / agro industrial waste.**
5. **Agro techniques for composting farm wastes and agro industrial wastes.**
6. **Recycling of crop wastes through vermin culture.**
7. **Preparation of Panchakavya .**
8. **Preparation of activated EM solution.**
9. **Nutritive analysis for estimating the potential of organics.**
10. **Application of various mulch materials to horticultural crops.**
11. **Nursery bed soil solarization.**
12. **Study of bio agents for crop protection.**
13. **Preparation of organic formulations for pest control.**
14. **Preparation of organic formulations for disease control.**
15. **Working out indices for organic fruit production.**
16. **Economic evaluation of organic fruit production system.**
17. **Visit to farmers field under organic fruit production.**

Course Outcome

CO1: The students will be able to recommend suitable organic package of practices for enhanced production of fruit crops.

CO2: They will be able to establish various organic input production units.

CO - PSO - PO Mapping

	PSO1	PSO2	PSO3	PSO4	PO1	PO2	PO3	PO4	PO5	PO6
CO1	X	X	X	X	X	X	X	X	X	X
CO2	X	X	X	X	X	X	X	X	X	X

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FSC 624 POST HARVEST TECHNOLOGY OF FRUIT CROPS (2+1)

Learning Objectives

- **To understand the basics and principles of post harvest technology.**
- **To provide information on the recent innovations in processing, packaging, storage and transport of fruit crops.**

Theory

Unit I Importance of post harvest technology and factors leading to post harvest losses

Post harvest technology- scenario in fruit crops - harvest indices - harvesting methods in fruit crops - harvesting practices for specific market requirements - influence of pre - harvest factors on post harvest quality and shelf life of fruit crops - factors leading to post harvest losses.

Unit II Physiology of ripening and post harvest treatments

Ripening of fruits - physiology and biochemistry of fruit ripening - ethylene action on ripening of fruits and ethylene management - pre-cooling - treatments prior to transport - chlorination- waxing- chemicals- bio control agents and natural plant products.

Unit III Storage methods

Storage methods- ventilated – refrigerated – MAS – CAS - physical injuries and disorders during storage

Unit IV Methods of preservation

Principles and methods of preservation - minimal processing of fruits – pretreatment-blanching - canning and irradiation - value addition of fruits - fruit juices – beverages - pickles - jam- jellies- marmalades- candies- glazed- crystallized fruits- dried and dehydrated products-nutritionally enriched- fortified products encapsulated fruit flavours.

Unit V Packing technologies and quality control standards

Packaging-technologies - packaging materials and transport- by -products from processing and its management- quality control and regulation of fresh and processed products- food safety standards.

Current Stream of Thought

Practical

Experiments on extension of shelf life - experiments on methods of preservation - changes occurring during preservation- various methods of preserving products-experiments to curtail spoilage- visit to food processing units.

Lecture schedule

1. **Post harvest technology scenario of fruit crops.**
2. **Harvest indices, physiological and horticultural maturity of important fruits, harvesting practices for specific market requirements.**
3. **Harvest indices, physiological and horticultural maturity of important sub tropical fruit crops** *viz.,* **pineapple, mandarins, jack, strawberry, grapes – harvesting practices for specific market requirements.**
4. **Harvest indices, physiological and horticultural maturity of important temperate fruit crops** *viz.,* **apple, pear, peach, plum – harvesting practices for specific market requirements .**
5. **Harvest indices, physiological and horticultural maturity of arid zone and minor fruit crops,** *viz.*, **pomegranate, annona, ber, date aonla, bael, woodapple, karonda, jamun, gambodge- harvesting practices for specific market requirements.**
6. **Influence of pre- harvest practices on post harvest quality and shelf life of fruits.**
7. **Major factors leading to post harvest losses.**
8. **Fruit ripening – climacteric and non- climacteric ripening.**
9. **Bio chemical and physiological changes during ripening.**
10. **Respiration and transpiration of fresh produce.**
11. **Ethylene evolution and ethylene management of fresh produce**
12. **Pre- cooling treatments prior to transport, chlorination.**
13. **waxing, chemicals, bio control agents and natural plant products.**
14. **Storage methods for fresh produces (ventilated, cold storage).**
15. **Modified atmospheric and controlled atmospheric storage (MAS, CAS)**

16. Disorders and injuries during storage.
17. Packaging technology – characteristics and selection
18. Mid - semester examination
19. Packaging materials – characteristics and selection.
20. Refrigerated transport system for fresh produce.
21. Minimal processing- Fresh cut produce- merits and demerits.
22. Cold chain in maintenance and supply chain management.
23. Principles and methods of preservation and processing
24. Pre- treatments – blanching and canning.
25. Value added products from horticultural crops – fruit juices and beverages.
26. Pickles.
27. Jam, jellies, marmalades.
28. Dried and dehydrated products
29. Nutritionally enriched or fortified products, encapsulated fruit flavours.
30. Packaging technology for processed products.
31. Integrated Pack House Facility for Fresh fruits.
32. Food safety standards –FPO, FSSAI,
33. Food safety standards – BIS,AGMARK,HACCP, ISO,
34. By - products from processing and its management (Briquetting, Kernel powder).

Practical schedule

1. Exercise on harvesting of fruits based on maturity indices.
2. Pre-cooling, grading, washing and waxing treatments.
3. Collection and practicing usage of various packaging materials.
4. Experiments to hasten ripening of fruits.
5. Experiments to delay ripening of fruits.
6. Exercise on storage of fruits.
7. Preparation of jams and jellies.
8. Preparation of squashes and RTS.
9. Preparation of marmalade.
10. Preparation of sauce.
11. Preparation of brine and syrup for preservation.
12. Preparation of pickles.
13. Practices in lye peeling and scalding.
14. Experiment on dehydration of fruits.
15. Preparation of candies and crystallized fruits.
16. Visit to commercial processing industries.
17. Project preparation for establishment of fruit processing industry.

Course Outcome

CO1:The students will be able to demonstrate different methods of processing of fruit crops

CO2:They will be able to prepare a proposal for establishing a fruit processing unit.

CO - PSO - PO Mapping

	PSO1	PSO2	PSO3	PSO4	PO1	PO2	PO3	PO4	PO5	PO6
CO1	X		X	X	X	X	X	X	X	X
CO2	X		X	X	X	X	X	X	X	X

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OPC- HOR 711 PROPAGATION AND NURSERY MANAGEMENT OF HORTICULTURAL CROPS (2+1)

Learning Objectives

- To make the students learn different methods of plant propagation.
- To impart knowledge on nursery management of various horticultural crops.
- To make them familiarize with the tools and implements essential for all horticultural operations.

Theory

Unit I Principles of plant propagation

Sexual and asexual methods of propagation - principles and factors influencing seed germination-dormancy- hormonal regulation of germination and seedling growth- seed quality- packing- storage- certification and testing.

Unit II Anatomical and physiological aspects of plant propagation

Techniques of cottage - layerage- graftage and budding- compatibility- dwarfing rootstocks of important fruit trees.

Unit III Plant growth regulators and plant tissue culture

Role of PGR'S in plant propagation- role of nucellar embryony- apomixes- tissue culture techniques- hardening techniques .

Unit IV Planning of a nursery unit and modern propagation structures

Raising of nursery plants- selection- certification maintenance of mother plants and bud wood and root stock nurseries- use of modern structures- mist chambers- low cost poly houses- tunnel houses.

Unit V Marketing methods of nursery plants and economics

Media/soil mixtures- containers- use of machinaries- lifting- packing- transport-marketing- economics of raising nursery and management in different fruit crops.

Current Stream of Thought

Practical

Media/soil mixture- containers and soil sterilisation- use of chemicals for seed treatment and sowing- preparation of nursery beds- polybags- seedpans- thumb rule for raising seedlings- stratification and scarification of seeds and use of tetrazolium salts for germination tests-identification of nucellar seedlings- practice of different asexual methods of propagation- viz.-cuttage- layering- budding- approach- veneer and softwood grafting-use of plant growth regulators in propagation of plants -use of mist chambers- modern propagation structures- low cost polyhouses- low tunnels and bottom heating techniques- selection- lifting- packing- transportation and marketing of nursery plants- economics of raising nurseries- visit to local commercial/private nurseries.

Lecture schedule

1. Scope and importance of plant propagation.
2. Study of sexual and asexual methods of propagation.
3. Advantages and disadvantages of seed and vegetative propagation.
4. Factors influencing seed germination of Horticultural crops.
5. Studies on dormancy, hormonal regulation of germination and seedling growth.
6. Study of seed quality, packing, storage, certification and testing.
7. Study of anatomical and physiological aspects of asexual propagation.

8. **Studies on graft compatibility on fruit crops.**
9. **Dwarfing rootstocks of commercial importance in fruit crops.**
10. **Role of PGR's in raising seedlings and rooting of cuttings and layers.**
11. **Role of nucellar embryony and apomixis.**
12. **Studies on tissue culture techniques.**
13. **Micro grafting (STG).**
14. **Techniques of cuttings and layering.**
15. **Techniques of budding and grafting.**
16. **Planning of nursery unit.**
17. **Mid-semester examination**
18. **Study of raising of nursery plants and their after care- role of protray nursery and their after care.**
19. **Study of modern propagation structures.**
20. **Role of mist chambers in plant propagation.**
21. **Study of bottom heating techniques.**
22. **Hardening techniques in nursery.**
23. **Progeny orchard and scion bank.**
24. **Establishment of bud wood bank.**
25. **Media -soil mixture preparation for nursery plants.**
26. **Study of containers used for nursery.**
27. **Use of machineries in nurseries.**
28. **Soil sterilization techniques.**
29. **Irrigation systems in nursery plants.**
30. **Lifting and packing of nursery plants.**
31. **Transportation and marketing of nursery plants.**
32. **Nursery planning and layout .**
33. **Economics of raising nursery and management of different fruit crops.**
34. **Nursery acts.**

Practical schedule

1. **Media/soil mixture, containers and soil sterilization.**
2. **Use of chemicals for seed treatment and sowing.**
3. **Preparation of nursery beds, polybags, seedpans, thumbrule for raising seedlings.**
4. **Stratification and scarification of seeds and use of tetrazolium salts for germination.**
5. **Identification of nucellar seedlings.**
6. **Practice of different asexual methods of propagation, viz.,cuttage, layering.**
7. **Buddingmethods.**
8. **Grafting- methods.**
9. **Use of plant growth regulators in propagation.**
10. **Role of mist chambers in plant propagation.**
11. **Other protected structures uses for plant propagation.**
12. **Low cost polyhouses, low tunnels.**
13. **Bottom heating techniques and soil sterilization.**
14. **Selection, lifting, packing of nursery plants.**
15. **Transportation and marketing of nursery plants.**
16. **Economics of raising nurseries.**
17. **Visit to local commercial/private nurseries.**

Course Outcome

CO1- gain knowledge on physiology, principles, factors influencing, media and methods of propagation of Horticultural crops

CO2-gain skill in all propagation methods and technology for commercial scale adoption

CO3- become capable of managing commercial nursery business.

CO - PSO - PO Mapping

	PSO1	PSO2	PSO3	PSO4	PO1	PO2	PO3	PO4	PO5	PO6
CO1	X		X	X	X	X	X	X	X	X
CO2	X		X	X	X	X	X	X	X	X
CO3	X		X	X	X	X	X	X	X	X

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OPC - FSC 712# GENETIC RESOURCES AND CONSERVATION OF FRUIT CROPS (2+1)

Learning Objectives

- **To provide an insight on the principles of biodiversity, strategies in conservation and utilization of fruit crop biodiversity.**
- **To provide information about under exploited fruits in India.**

Theory

Unit I Importance of biodiversity and methods of conservation

Biodiversity and conservation- issues and goals- centers of origin of cultivated fruits- primary and secondary centers of genetic diversity- present status of gene centers- exploration and collection of germplasm- conservation of genetic resources- *in situ* and *ex situ* germplasm conservation- problem of recalcitrancy- cold storage of scions- tissue culture- cryopreservation- pollen and seed storage- inventory of germplasm.

Unit II Role of National institutes in conservation and plant quarantine

Introduction of germplasm- plant quarantine- role of National institutes in conservation- TBGRI- NBPGR, etc-Intellectual property rights- regulatory horticulture-plant variety protection authority- maintenance of core group using traditional knowledge for plant conservation.

Unit III Bio diversity of tropical fruit crops

Biodiversity of major tropical fruit crops - Mango- banana- sweet orange- lime-lemon- sapota- papaya- guava- pomegranate- pineapple- annona and avocado.

Unit IV Bio diversity of sub tropical and temperate fruit crops

Biodiversity of major sub tropical- temperate fruit and nut crops - grapes-mandarin- mangosteen- litchi- fig- apple- pear- plum- peach- strawberry- almond-apricot and walnut.

Unit V Bio diversity of under exploited minor fruit crops

Under exploited minor fruits -present status and scope- their origin-distribution- biodiversity- conservation and utilization of minor fruits.

Current Stream of Thought

Practical

Documentation of germplasm maintenance of passport data and other records of accessions; field exploration trips- exercise on *ex situ* conservation cold storage-pollen/seed storage- cryopreservation- visits to National Gene Bank and other centers of PGR activities.

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Lecture schedule

1. **Bio diversity – introduction, principles, goals and issues in conservation.**
2. **Genetic diversity- occurrence and distribution.**
3. **Exploration, collection, characterization, documentation and cataloguing of germplasm.**
4. **Present status of National and International gene banks.**
5. **Role of national institutes in conservation-TBGRI, NBPGR.etc.**
6. **Germplasm exchange, Material Transfer Agreement and current quarantine protocols.**
7. **Methods for** *ex situ* **conservation of germplasm and** *in situ* **conservation of germplasm.**
8. **Use of GIS and documentation of local biodiversity.**
9. **Horticultural cropping systems and implication on biodiversity .**
10. **Impact of climate change on biodiversity.**
11. **Advances and issues in conservation of biodiversity though recalcitrant and orthodox seeds.**
12. **Advances and issues in conservation of biodiversity through vegetative propagation.**
13. **Intellectual Property Rights, Plant Variety Protection Authority .**
14. **Status of biodiversity of mango.**
15. **Status of biodiversity of banana.**
16. **Status of biodiversity of sweet orange, lime and lemon.**
17. **Mid-semester examination**
18. **Status of biodiversity of sapota and papaya.**
19. **Status of biodiversity of guava and pomegranate.**
20. **Status of biodiversity of pineapple and annona.**
21. **Status of biodiversity of avocado and mangosteen.**
22. **Status of biodiversity of grapes.**
23. **Status of biodiversity of mandarin .**
24. **Status of biodiversity of litchi and fig.**
25. **Status of biodiversity of apple and pear.**
26. **Status of biodiversity of plum and peach.**
27. **Status of biodiversity of strawberry .**
28. **Status of biodiversity of almond and apricot.**
29. **Status of biodiversity of walnut.**
30. **Under exploited minor fruit crops - present status and scope**

31-34. **Minor fruits - origin, distribution - biodiversity, propagation, conservation and utilization.**

Practical schedule

1. **Field exploration trips- exercise in collection and characterization**
2. **Visit to field germplasm unit and documentation of germplasm**
3. **Practices in maintenance of passport data**
4. **Practical study of** *ex situ* **conservation methods**
5. **Practical study of** *in situ* **conservation methods**
6. **Methods of seed storage for short and long term conservation**
7. **Methods of conservation using vegetative propagules**
8. *In vitro* **conservation protocols**
9. **Study of species diversity in horticultural cropping system**
10. **Visit to regional conservation centres**
11. **Visit to subtropical and temperate zone orchards**
12. **Characterization of banana germplasm**
13. **Characterization of papaya germplasm**
14. **Characterization of mango germplasm**
15. **Identification of minor fruit crops and their description.**
16. **Use of molecular tools for characterizing species diversity**
17. **Estimating extent of diversity through collection and analysis of data**

Course Outcome

CO1:The students will be able to understand the strategies in conservation and utilization of fruit crop biodiversity

CO2:They will be able to demonstrate different techniques in *ex -situ* conservation.

CO3:They will be able to identify underutilized minor fruit crops.

CO - PSO - PO Mapping

	PSO1	PSO2	PSO3	PSO4	PO1	PO2	PO3	PO4	PO5	PO6
CO1	X		X			X		X	X	X
CO2	X		X			X		X	X	X
CO3	X		X			X		X	X	X

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DEPARTMENT OF HORTICULTURE
GHOR 22 M.Sc. (HORTICULTURE) IN VEGETABLE SCIENCE

Programme Outcome:

Any post graduate from the Faculty of Agriculture will

PO1. have core knowledge leading to awareness on advancements in the field of agriculture and horticulture including crop production, soil fertility, crop protection, crop improvement, microbiology, bio technology, agricultural extension and economics.

PO2. have basic understanding and skill on experimental tools in biological sciences, analytical techniques for plant and soil samples, microbial technologies, biotechnological tools, breeding methods, statistical tools & analysis, research data computation, etc, required for higher learning, research and development.

PO3. be mastering the modern agronomic techniques of crop production, water, soil & nutrient management, plant protection with respect to insect pest and plant diseases , crop improvement and ecosystem restoration.

PO4. will be able to design and execute individual research project, write concise & persuasive research articles and communicate effectively with their scientific colleagues, farmers and the general public.

PO5. be able to communicate research and educational materials properly and competently and

PO6. be able to address complex problems taking into account related ethical, social, legal, economic, and environmental issues.

Programme Specific Outcome

The student will be able to

PSO1- acquire knowledge on crop improvement, production technologies, and post harvest technologies pertaining to vegetable crops.

PSO2- recommend suitable package of practices to various stake holders.

PSO3- carryout individual research works in vegetable crops and writing reports.

PSO4- become eligible to work in commercial horticultural units, research projects, post harvest industries, etc.

GHOR 22 M.Sc. (HORTICULTURE) IN VEGETABLE SCIENCE
DISTRIBUTION OF COURSES

S. No.	Course Code	Course Title	Credit Hours
		Major courses	
1.	VSC 611	Breeding of Vegetable crops	2+1
2.	VSC 612	Production technology of warm season vegetable crops	2+1
3.	VSC 613	Systematics of vegetable crops	2+1
4.	HOR 621 HOR 622	Growth regulation and stress management in horticultural crops (or) Protected and precision horticulture	2+1
5.	VSC 621	Production technology of cool season vegetable crops	2+1
6.	VSC 622 VSC 623	Biotechnology of vegetable crops (or) Organic vegetable production	1+1
7.	VSC 624	Principles and processing of vegetable crops	2+1
			13+7=20
8.	VSC 011/021/031/041	Research (0+1)+(0+2)+(0+8)+(0+9)	0+20
9.	VSC 032	Seminar	0+1
		Minor course	
1.	OPC-GPB 621	Concepts of crop physiology	2+1
2.	OPC-XXX	Minor course from other departments /related disciplines	2+1
3.	OPC-XXX	Minor course from other departments /related disciplines	2+1
			6+3=9
		Supporting courses	
1.	STA 611	Statistical methods and design of experiments	2+1
2.	COM 611	Computer applications for agricultural research	1+1
			3+2=5
		Non - credit compulsory courses	
1.	PGS 611	Agricultural research ethics and methodology	1+0
2.	PGS 612	Technical writing and communication skills	0+1
3.	PGS 623	Basic concepts in laboratory techniques	0+1
4.	PGS 624	Library and information services	0+1
5.	PGS 715*	Intellectual property rights and its management in agriculture	1+0
6.	PGS 716*	Disaster management	1+0
			2+4=6

*** e-course**

GHOR 22 M.Sc. (HORTICULTURE) IN VEGETABLE SCIENCE

SEMESTER WISE DISTRIBUTION OF COURSES

SEMESTER I			
S. No.	**Course Code**	**Course Title**	**Credit Hours**
1.	VSC 611	Breeding of vegetable crops	2+1
2.	VSC 612	Production technology of warm season vegetable crops	2+1
3.	VSC 613	Systematics of vegetable crops	2+1
4.	STA 611	Statistical methods and design of experiments	2+1
5.	COM 611	Computer applications for agricultural research	1+1
6.	VSC 011	Research	0+1
7.	PGS 611	Agricultural research ethics and methodology *	0+1
8.	PGS 612	Technical writing and communication skills *	0+1

SEMESTER-II			
S. No.	**Code No.**	**Courses**	**Credit Hours**
1.	HOR 621 HOR 622	Growth regulation and stress management in horticultural crops (or) Protected and precision horticulture	2+1
2.	VSC 621	Production technology of cool season vegetable crops	2+1
3.	VSC 622 VSC 623	Biotechnology of vegetable crops (or) Organic vegetable production	1+1
4.	VSC 624	Principles and processing of vegetable crops	2+1
5.	VSC 021	Research	0+2
6.	OPC-GPB 621	Concepts of crop physiology	2+1
7	PGS 623	Basic concepts in laboratory techniques*	0+1
8	PGS 624	Library and information services *	0+1

Semester-III			
S. No.	**Code No.**	**Courses**	**Credit Hours**
1.	OPC-XXX	Minor course from other departments /related disciplines	2+1
2.	OPC-XXX	Minor course from other departments /related disciplines	2+1
	OPC-HOR 711#	Propagation and nursery management of horticultural crops	2+1
	OPC-VSC 712#	Hi-tech vegetable production	2+1
3.	VSC 031	Research	0+8
4.	VSC 032	Seminar	0+1
5.	PGS 715	Intellectual property rights and its management in agriculture *	1+0
6.	PGS 716	Disaster management *	1+0
7.	PGS 717	Constitution of India *	1+0

Semester-IV			
S. No.	**Code No.**	**Courses**	**Credit Hours**
1.	VSC 041	Research	0+9
2.	VASC	Value added course*	3+0

#-Optional course offered to other departments/discipline only
***Non – credit Compulsory course**

ABSTRACT

Course	Semester wise credit distribution				Total
	I	II	III	IV	
Major	9	11	-	-	20
Minor	-	3	6	-	9
Supporting	5	-	-	-	5
Seminar	-	-	1	-	1
Research	1	2	8	9	20
Total credits	15	16	15	9	55
Non-credit	Two courses	Two courses	Three courses	One Course	Eight courses

VSC 611 BREEDING OF VEGETABLE CROPS (2+1)

Learning Objectives

- **To educate principles and practices adopted for breeding of vegetable crops.**
- **To impart knowledge on various methods of breeding and varieties released**

Theory

Origin- botany- taxonomy- cytogenetics- genetics- breeding objectives- breeding methods (introduction- selection- hybridization- mutation)- varieties and varietal characterization- resistance breeding for biotic and abiotic stress- quality improvement- molecular markers- genomics- marker assisted breeding and QTLs- biotechnology and their use in breeding in vegetable crops- issue of patenting- PPVFR act of the following crops:.

Unit I Breeding of solanaceous vegetables

Tomato, brinjal, chilli and sweet pepper.

Unit II Breeding of cucurbitaceous vegetables

Cucurbitaceous vegetables.

Unit III Cool season vegetables

Cabbage, cauliflower, carrot, beet root and radish.

Unit IV Bulb and tuber crops

Onion, garlic, potato, tapioca and sweet potato.

Unit V Greens and beans

Okra, moringa, peas, beans and amaranthus.

Current Stream of Thought

Practical

Modes of pollination and reproduction- pollen morphology and viability- palanological studies- selfing and crossing techniques in vegetable crops- assessment of variability- estimation of genetic distance- techniques of hybridization in vegetable crops- emasculation and hybridization- techniques of handling segregating progenies- D^2 analysis- heterosis and combining ability- diallel and line x tester analysis- assessment of character association- path analysis- study of superior varieties and hybrids in vegetable crops- visit to vegetable crops breeding centers and research institutes.

Lecture schedule

Origin- botany and taxonomy- genetics- cytogenetics- plant genetic resources- anthesis- pollination- fertilization mechanism- sterility and incompatability- constraints- breeding objectives- methods and achievements of the following crops:

1-2. Tomato.
3-4. Brinjal.
5-6. Chilli.
7. Sweet pepper.
8. Bitter gourd.
9. Ridge gourd.
10. Pumpkin.
11. Ash gourd.
12. Watermelon.
13. Muskmelon.
14. Cabbage.
15. Cauliflower.
16. Carrot.
17. Mid -semester examination
18. Beet root.
19. Radish .
20-21.Onion.
22. Garlic .
23-24. Potato.
25. Tapioca.
26. Sweetpotato.

27-28. Okra.
29. Moringa.
30. Peas.
31. Beans.
32. Amaranthus.
33. Issue of patenting, PPVFR act.
34. Marker assisted breeding and QTL.

Practical schedule

1. **Study of pollination mechanisms, pollen morphology and viability in solanaceous vegetable crops.**
2. **Study of pollination mechanisms, pollen morphology and viability in cucurbits.**
3. **Study of pollination mechanisms, pollen morphology and viability in crucifers.**
4. **Assessment of variability for vegetable improvement.**
5. **Estimation of genetic distance – D^2 analysis**
6. **Estimation of heterosis and combining ability**
7. **Study of diallel and line x tester analysis**
8. **Study of correlation and path analysis**
9. **Floral biology and techniques of hybridization in solanaceous vegetables.**
10. **Floral biology and techniques of hybridization in leguminous vegetables.**
11. **Floral biology and techniques of hybridization in cucurbitaceous vegetables.**
12. **Practices in breeding methods of cruciferous vegetable crops.**
13. **Practices in breeding methods of potato, tapioca and sweet potato.**
14. **Practices in breeding methods of root vegetables.**
15. **Practices in breeding methods of onion and garlic.**
16. **Practices in breeding methods of moringa and amaranthus.**
17. **Practices in breeding methods of okra.**

Course Outcome

CO1- Students will be able to understand the different breeding methods followed in vegetable crops.

CO2- They will be able to demonstrate and carry out different techniques employed in breeding of vegetable crops.

CO - PSO - PO Mapping

	PSO1	PSO2	PSO3	PSO4	PO1	PO2	PO3	PO4	PO5	PO6
CO1	X		X		X	X		X	X	X
CO2	X			X	X	X		X	X	X

References

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VSC 612 PRODUCTION TECHNOLOGY OF WARM SEASON VEGETABLE CROPS (2 + 1)

Learning Objectives

- To educate production technology of warm season vegetables.
- To impart knowledge on various cultivation practices in warm season vegetables
- To educate hi-tech vegetable cultivation under protected conditions

Theory

Introduction- commercial varieties / hybrids- climatic and soil requirements- seed rate and seed treatment- nursery management- protray nursery -sowing/planting -cropping systems- nutrient management- fertigation- irrigation management- plant growth regulators- intercultural operations- weed management- mulching- physiological disorders and corrective measures- biotic stresses and their management- organic production technologies- maturity standards- harvesting- seed production techniques- protected cultivation of the following crops:

Unit I Production techniques of solanaceous vegetables

Tomato, brinjal, chilli and sweet pepper

Unit II Bhendi and leguminous vegetables

Okra, dolichos beans, cowpea and cluster bean

Unit III Cucurbitaceous vegetables

Cucurbitaceous vegetables, pumpkin, gourds and melons, perennial cucurbitaceous, vegetables

Unit IV Tuber crops and other minor tubers

Tapioca, sweet potato, elephant foot yam, taro and minor tuber crops

Unit V Green leafy vegetables and under exploited vegetables

Onion, moringa, amaranthus, underexploited and lesser known vegetables

Current Stream of Thought

Practical

Description of commercial varieties and hybrids- seed treatment and nursery practices- study of nutritional and physiological disorders- identification of biotic stresses- role of mineral elements- deficiency symptoms- preparation of cropping schemes for commercial farms- experiments to demonstrate the role of mineral elements- application of plant growth regulators in vegetables- seed extraction techniques- identification of important pests and diseases and their control- economics of warm season vegetable crops- maturity standards and harvesting- seed production techniques- cost economics of the following crops.

Lecture schedule

1. Introduction and classification scope and importance of warm season crops.
2-4. Tomato
5-7. Brinjal
8-10. Chillies
11. Sweet pepper
12-13. Okra
14-15. Dolichos bean
16. Cowpea
17. Mid-semester examination
18. Cluster bean
19. Ash gourd and pumpkin
20. Bottle gourd and ridge gourd
21. Bitter gourd and snake gourd
22. Watermelon and muskmelon
23. Cucumber, gherkin and coccinea
24-26. Tapioca
27. Sweet potato

28. **Elephant foot yam and minor tuber crops**
29. **Bellary onion**
30. **Aggregatum onion**
31. **Moringa**
32. **Amaranthus**
33. **Underexploited vegetables crops**
34. **Lesser known vegetables crops**

Practical schedule

1. **Description of commercial varieties / hybrids in solanaceous vegetables.**
2. **Description of commercial varieties / hybrids in cucurbits.**
3. **Description of commercial varieties / hybrids in okra, onion and moringa.**
4. **Description of commercial varieties / hybrids in tapioca and sweet potato.**
5. **Seed treatment and nursery practices in summer vegetables.**
6. **Fertigation practices in vegetables.**
7. **Assessing the efficiency of plant growth regulators in warm season vegetables.**
8. **Identification of biotic stresses in warm season vegetables.**
9. **Assessing the maturity standards and harvest indices in solanaceous vegetables and okra.**
10. **Assessing the maturity standards and harvest indices in cucurbits, onion and dolichos bean.**
11. **Seed production techniques in solanaceous vegetables.**
12. **Seed production techniques in cucurbits.**
13. **Seed production techniques in okra and onion**
14. **Preparation of cropping scheme for commercial farms.**
15. **Visit to vegetable markets.**
16. **Working out cost economics for commercial cultivation of warm season Vegetables**
17. **Protected cultivation of tropical vegetables.**

Course Outcome

CO1-Students will be able to appreciate the research advancements made in the Warm season vegetables crops.

CO2-They will be able to recommend suitable package of practices for enhanced production of warm season vegetables.

CO - PSO - PO Mapping

	PSO1	PSO2	PSO3	PSO4	PO1	PO2	PO3	PO4	PO5	PO6
CO1	X	X	X	X	X	X	X	X	X	X
CO2	X	X	X	X	X	X	X	X	X	X

References

1. **Bose, T.K., J. Kabir, T. K. Maity, V. A. Parthasarathy and M. G. Som 2003. Vegetable Crops. Vol. I-III. Naya Prakash Publications, Kolkatta.**
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9. **Thamburaj, S. and N. Singh. 2004. Vegetables, Tuber Crops and Spices. ICAR., New Delhi.**

VSC 613 SYSTEMATICS OF VEGETABLE CROPS (2+1)

Learning Objectives

- **The impart knowledge on International code of nomenclature of vegetable crops**
- **To educate morphological, cytological and molecular taxonomy of vegetable crops.**

Theory

Unit I Classification and international code of vegetable crops

Principles of classification- different methods of classification- salient features of international code of nomenclature of vegetable crops.

Unit II Evolving and botany of tropical vegetables

Origin, history- evolution and distribution of vegetable crops- botanical description of families- genera and species covering various tropical vegetables.

Unit III Evolution and botany of temperate vegetables

Origin, history- evolution and distribution of vegetable crops- botanical description of families- genera and species covering various temperate vegetables.

Unit IV Cytology and descriptions for vegetables

Cytological level of various vegetable crops- descriptive keys for important vegetables.

Unit V Molecular markers in vegetable crops

Importance of molecular markers in evolution of vegetable crops, molecular markers as an aid in characterization and taxonomy of vegetable crops.

Current Stream of Thought

Practical

Identification, description- classification and maintenance of vegetable species and varieties- survey- collection of allied species and genera locally available- preparation of keys for species and varieties- methods of preparation of herbarium and specimens.

Lecture schedule

1. **Principles of classification of vegetables.**
2. **Methods of classification of vegetables.**
3. **Salient features of international code of nomenclature of vegetable crops.**
4. **Origin, history, evolution and distribution of vegetable crops.**
5. **Botanical description of genera and species of solanaceae family – tomato.**
6. **Botanical description of genera and species of solanaceae family – chilli and sweet pepper.**
7. **Botanical description of genera and species of solanaceae family – brinjal.**
8. **Botanical description of genera and species of solanaceae family – potato.**
9. **Botanical description of genera and species of cucurbitaceae family- pumpkin and ash gourd.**
10. **Botanical description of genera and species of cucurbitaceae family- ribbed gourd, bottle gourd, bitter gourd and snake gourd.**
11. **Botanical description of genera and species of cucurbitaceae family- watermelon and muskmelon.**
12. **Botanical description of genera and species of cucurbitaceae family- cucumber and gherkin.**
13. **Botanical description of genera and species of cucurbitaceae family- chow chow and coccinia.**
14. **Botanical description of genera and species of alliaceae family.**
15. **Botanical description of genera and species of cruciferae family – cabbage, cauliflower.**
16. **Botanical description of genera and species of cruciferae family – knol-khol, turnip and radish.**
17. **Mid -semester examination.**
18. **Botanical description of genera and species of umbelliferae family.**
19. **Botanical description of genera and species of chenopodiaceae family.**
20. **Botanical description of genera and species of fabaceae family – peas and cowpea.**
21. **Botanical description of genera and species of fabaceae family – french beans, dolichos beans and cluster beans.**

22. **Botanical description of genera and species of moringaceae family.**
23. **Botanical description of genera and species of amaranthaceae family.**
24. **Botanical description of genera and species of malvaceae family.**
25. **Botanical description of genera and species of asteraceae family.**
26. **Botanical description of genera and species of euphorbiaceae family.**
27. **Botanical description of genera and species of convolvulaceae family.**
28. **Botanical description of genera and species of araceae family.**
29. **Botanical description of genera and species of dioscoreaceae family.**
30. **Botanical description of genera and species of labiatae family.**
31. **Cytological level of various vegetable crops.**
32. **Descriptive keys for important vegetables**
33. **Importance of molecular markers in evolution of vegetable crops.**
34. **Molecular markers as an aid in characterization and taxonomy of vegetable crops.**

Practical schedule

1. **Identification, description, classification and maintenance of vegetable species and varieties of solanaceae family.**
2. **Identification, description, classification and maintenance of vegetable species and varieties of cucurbitaceae family - gourds.**
3. **Identification, description, classification and maintenance of vegetable species and varieties of cucurbitaceae family - melons.**
4. **Identification, description, classification and maintenance of vegetable species and varieties of alliaceae family.**
5. **Identification, description, classification and maintenance of vegetable species and varieties of cruciferae family.**
6. **Identification, description, classification and maintenance of vegetable species and varieties of umbelliferae family.**
7. **Identification, description, classification and maintenance of vegetable species and varieties of chenopodiaceae family.**
8. **Identification, description, classification and maintenance of vegetable species and varieties of fabaceae family.**
9. **Identification, description, classification and maintenance of vegetable species and varieties of moringaceae family.**
10. **Identification, description, classification and maintenance of vegetable species and varieties of amaranthaceae family.**
11. **Identification, description, classification and maintenance of vegetable species and varieties of malvaceae family.**
12. **Identification, description, classification and maintenance of vegetable species and varieties of asteraceae family.**
13. **Identification, description, classification and maintenance of vegetable species and varieties of euphorbiaceae and convolvulaceae families.**
14. **Identification, description, classification and maintenance of vegetable species and varieties of araceae, dioscoreaceae and labiatae families.**
15. **Collection of locally available allied species, genera and preparation of keys for the species and varieties.**
16. **Methods of preparation of herbarium.**
17. **Methods of preparation of specimens.**

Course Outcome

CO1: Students will gain knowledge on morphological, cytological and molecular taxonomy of vegetable crops.

CO2: They will be able to classify the vegetables based on morphological, cytological and molecular taxonomy characters

CO3:They will gain knowledge on the importance of molecular markers in evolution of vegetable crops

CO - PSO - PO Mapping

	PSO1	PSO2	PSO3	PSO4	PO1	PO2	PO3	PO4	PO5	PO6
CO1	X		X	X		X			X	
CO2	X		X	X		X			X	
CO3	X		X	X		X			X	

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1. Dutta, A.C. 1986. A Class Book of Botany. Oxford Univ. Press., New Delhi.
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VSC 621 PRODUCTION TECHNOLOGY OF COOL SEASON VEGETABLE CROPS (2 + 1)

Learning Objectives

- To educate production technology of cool season vegetables.
- To impart knowledge on various cultivation practices in cool season vegetables
- To educate hi-tech vegetable cultivation under protected conditions

Theory

Introduction- commercial varieties and hybrids- climatic and soil requirements- seed rate- seed treatment- nursery management- sowing / planting cropping systems- nutrient management fertigation- role of plant growth regulators- irrigation management physiological disorders and corrective measures- major biotic stresses and their management- intercultural operations- mulching- weed management- organic production technologies- maturity standards- harvesting seed- production techniques of the following crops:

Unit I Production technology of cole crops

Cole crops – cabbage, cauliflower, knolkhol, sprouting broccoli and brussel sprouts.

Unit II Production technology of root crops

Root crops - carrot, radish, turnip and beetroot.

Unit III Tuber and bulb crops

Potato and garlic.

Unit IV Leguminous vegetables

Peas, french beans, lima beans and other temperate beans

Unit V Leafy vegetables and perennial temperate vegetables

Leafy vegetables- lettuce, celery, spinach, chinese cabbage. Perennial vegetables- chow chow, asparagus, globe artichoke, rhubarb.

Current Stream of Thought

Practical

Description of commercial varieties and hybrids, seed treatment and nursery practices, study of nutritional and physiological disorders- mulching- experiments to demonstrate the role of mineral elements and plant growth regulators- maturity standards and harvesting- preparation of cropping scheme for commercial farms- seed production techniques.

Lecture schedule

1. Introduction, classification, scope and importance of cool season vegetables.

Commercial varieties / hybrids, climate and soil requirements, seed rate, nursery management sowing / planting , nutrient management, PGR's, irrigation management, physiological disorders and corrective measures, major biotic stresses and their management, intercultural operations, mulching, weed management, maturity standards and seed production techniques of the following crops :

2-4. Cabbage

5-7. Cauliflower

8. Precision production technology for cabbage and cauliflower.

9. Knol khol

10. Sprouting broccoli

11. Brussel sprouts

12-14. Carrot

15. Radish

16. Turnip

17. Mid-semester examination.

18. Beetroot

19-21. Potato

22. Garlic

23-24. Peas and French beans

25-26 lima beans and broad beans

27. Lettuce

28. Celery

29. Spinach

30. Chinese cabbage

31. Chow chow

32. Asparagus

33. Globe artichoke

34. Rhubarb

Practical schedule

1. **Description of commercial varieties / hybrids in crucifers.**
2. **Description of commercial varieties / hybrids in potato.**
3. **Description of commercial varieties / hybrids in root vegetables.**
4. **Description of commercial varieties / hybrids in peas and beans.**
5. **Seed treatment and nursery practices.**
6. **Fertigation practices in cool season vegetables**
7. **Study of nutritional and physiological disorders and their remedies.**
8. **Preparation of growth regulators and their application.**
9. **Maturity standards and harvest indices of crucifers, peas and beans.**
10. **Maturity standards and harvest indices of potato and root vegetables.**
11. **Seed production techniques in crucifers.**
12. **Seed production techniques in potato and root vegetables.**
13. **Seed production techniques in peas and beans.**
14. **Identification of biotic stresses in cool season vegetables.**
15. **Preparation of cropping scheme for commercial farms.**
16. **Visit to commercial vegetable production units / markets.**
17. **Working out cost economics.**

Course Outcome

CO1-Students will be able to appreciate the research advancements made in the cool season vegetables crops.

CO2-They will be able to recommend suitable package of practices for enhanced production of cool season vegetables.

CO - PSO - PO Mapping

	PSO1	PSO2	PSO3	PSO4	PO1	PO2	PO3	PO4	PO5	PO6
CO1	X	X	X	X	X	X	X	X	X	X
CO2	X	X	X	X	X	X	X	X	X	X

References

1. **Bose, T.K., J. Kabir, T. K. Maity, V. A. Parthasarathy and M. G. Som 2003. Vegetable Crops. Vol. I-III. Naya Prakash Publications, Kolkatta.**
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VSC 622 BIOTECHNOLOGY OF VEGETABLE CROPS (1+1)

Learning Objectives

- **To impart an understanding on the principles and role of biotechnology in vegetable crop improvement.**
- **To teach skills in various methods of biotechnology**

Theory

Unit I Importance of biotechnology and factors affecting tissue culture

Bio-technology and its scope in vegetable crops- influence of plant materials- physical-chemical factors and growth regulators on growth and development of plant cell- tissue and organ cultures.

Unit II Techniques in biotechnology- I

Callus culture - types- cell division- differentiation- organogenesis- embryogenesis- organ culture- meristem- embryo- endosperm- anther- ovule culture- embryo rescue- rapid clonal propagation- somaclonal variations.

Unit III Techniques in biotechnology -II

Ex vitro **establishment of tissue cultured plants- physiology of hardening - hardening and field transfer- use of bioreactors and** *in vitro* **methods for production of secondary metabolites- suspension cultures- regeneration of tissues-** *in vitro* **pollination and fertilization-** *in vitro* **mutation.**

Unit IV Techniques in biotechnology- III

Protoplast culture and fusion- construction and identification of somatic hybrids and cybrids- wide hybridization- artificial seeds cryopreservation

Unit V Techniques in biotechnology -IV

Genetic engineering in vegetable crops- application of molecular techniques for identification and characterization of different types of vegetables- i*n vitro* **selection for biotic and abiotic stress- achievements of biotechnology in vegetable crops.**

Current Stream of Thought

Practical

An exposure to tissue culture laboratories- media preparation- inoculation of explants for clonal propagation- callus induction and culture- regeneration of plantlets from callus- sub-culturing- techniques on anther- ovule- embryo culture- somaclonal variation- *in vitro* **mutant selection against abiotic stress- development of protocols for**

mass multiplication- project development for establishment of commercial tissue culture laboratory.

Lecture schedule

1. **Role of biotechnology in vegetable crops.**
2. **Influence of plant materials physical and chemical physical factors on growth and development of plant cell tissues and organs.**
3. **Callus cultures, differentiation, organagenisis and somatic embryogenesis.**
4. **Meristem culture for disease elimination.**
5. **Production of haploids and dihaploids through anther, pollen and ovule culture.**
6. **Embryo culture and endospem culture techniques.**
7. **Rapid** *in vitro* **clonal propagation through direct organogenesis.**
8. **Hardening and establishment of tissue cultured plantlets in the primary, secondary nursery and field.**
9. **Mid-semeser examination.**
10. **Somaclonal variations and its applications.**
11. *In vitro* **production of secondary metabolites.**
12. **Techniques of** *in vitro* **pollination and fertilization and** *in-vitro* **mutation.**
13. **Protoplast culture and regeneration and protoplast fusion.**
14. **Synthetic seed production techniques.**
15. *In vitro* **conservation and cryopreservation techniques.**
16. **Genetic engineering and transgenics.**
17. **Vectors and methods of transformation.**

Practical schedule

1. **Components of tissue culture laboratory.**
2. **Laboratory equipments-uses and methods of operation.**
3. **Nutrient stock and growth regulator stock preparation.**
4. **Culture media preparation.**
5. **Sterilization techniques for glassware and media.**
6. **Inoculation of explants for direct organogenesis.**
7. **Inoculation of explants for callus culture.**
8. **Clonal propagation through meristem culture.**
9. **Anther, pollen and ovule culture.**
10. **Sub-culturing techniques for regeneration.**
11. **Induction of multiple shoots and roots.**
12. *In vitro* **screening of cell lines for abiotic stress.**
13. *In vitro* **mutation for abiotic stress.**
14. **Synthetic seed production.**
15. **Hardening techniques.**
16. **Visit to leading commercial tissue culture units.**
17. **Project preparation for establishment of tissue culture labs.**

Course Outcome

CO1;The students will gain knowledge on the importance of biotechnology in crop improvement.

CO2:The students will be able to demonstrate different techniques in biotechnology.

CO3:They will be able to prepare a proposal for establishment of a tissue culture laboratory.

CO - PSO - PO Mapping

	PSO1	PSO2	PSO3	PSO4	PO1	PO2	PO3	PO4	PO5	PO6
CO1	X		X	X	X	X		X	X	X
CO2	X		X	X	X	X		X	X	X
CO3	X		X	X	X	X		X	X	X

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VSC 623 ORGANIC VEGETABLE PRODUCTION (1+1)

Learning Objectives

- To educate principles, concepts and production of organic farming in vegetable crops.
- To impart knowledge on special techniques followed in organic vegetable cultivation.

Theory

Unit I Importance of organic production of vegetable crops

Scope- importance- principles- perspective- concepts and components of organic production of vegetable crops- global and Indian scenario of organic vegetable production- history and development of organic farming in India and world.

Unit II Soil health in organic horticulture

Soil health – concepts – problem diagnosis – conservation of soil – problem soil reclamation under organic horticulture – soil physical- chemical and biological improvement – organic carbon status and improvement strategies – C:N ratio and its influence on nutrient availability and methodology to improve organic carbon status.

Unit III Bio inputs in organic horticulture

Organic manures -FYM- coirpith- vermicompost- pressmud- oilcake- biofertilizers- biodynamics preparation etc.- indigenous methods of compost preparation- methods for enhancing soil fertility- mulching- raising green manure crops- role of botanicals- panchagavvya- humic acid- sea weed extract- manchurian mushroom tea and vermiwash and em technology- ITK's in organic farming- role of bio-control agents - non chemical weed- pest and disease control.

Unit IV Organic production technology of vegetable crops

Organic production of vegetables crops- *viz.*- solanaceous crops- cucurbits- cole crops- root and tuber crops.

Unit V GAP and GMP- Certification of organic products

GAP and GMP- certification of organic products; agencies involved- organic production and export - opportunity and challenges- processing and quality control for organic foods -sustainability indices for evaluating long term and indirect benefits of organic farming- economic evaluation of organic horticultural technologies – net returns and B:C ratio.

Current Stream of Thought

Practical

Soil physical parameters with relevance to organic horticulture- method of preparation of compost- vermicomposting- biofertilizers- soil solarization- bio pesticides in horticulture- green manuring- mycorrhizae and organic crop production- waste management- organic soil amendment for root disease- weed management in organic horticulture- visit to organic fields and marketing centres

Lecture Schedule

1. **Scope and importance of organic horticulture and its merits and demerits. Global and Indian scenario of organic horticulture.**
2. **History and development of organic farming in India and World.**
3. **Soil problems and its reclamation through organic horticulture.**
4. **Soil physical, chemical and biological properties and conservation of soil resource under organic horticulture.**
5. **Importance of C:N ratio, its influence on nutrient availability and methodology to improve organic carbon status.**
6. **Bulky and concentrated organic manures.**
7. **Green manures, biofertilizers and bio dynamic farming.**
8. **Role of botanicals, panchagavvya, humic acid, sea weed extract, Manchurian mushroom tea and vermiwash and EM technology,**
9. **Mid- semester examination.**
10. **Role of ITK's in organic farming**
11. **Organic cultivation of solanceous crops**
12. **Organic production of cucurbits and cole crops**
13. **Organic production of root and tuber crops**
14. **Non -chemical weed,pest and disease control**
15. **GAP and GMP in organic production - Organic certification – standards and agencies – marketing and export avenues for organic produce.**
16. **Sustainability indices for evaluating indirect benefits of organic farming and Processing and quality control for organic foods**
17. **Economic evalution of organic horticultural technologies – net returns and B:C ratio.**

Practical schedule

1. **Soil physical parameters with relevance to organic horticulture.**
2. **Estimate on soil chemical parameters (pH, EC and ESP).**
3. **Estimation of Soil biological paremeters.**
4. **Nursery bed soil solarization for vegetable crops.**
5. **Agro techniques for composting farm wastes and agro industrial wastes.**
6. **Recycling of crop wastes through vermiculture.**
7. **Preparation of panchakavya humic acid and sea weed extract.**
8. **Preparation of activated EM solution,Manchurian mushroom tea and vermiwash .**
9. **Organic production of vegetable crops.**
10. **Application of various mulch materials to horticultural crops.**
11. **Study of bio agents for crop protection.**
12. **Preparation of organic formulations for pest control.**
13. **Preparation of organic formulations for disease control.**
14. **Organic certification, standards and agencies.**
15. **Working out indices for organic horticulture.**
16. **Economic evaluation of organic horticulture system.**
17. **Visit to farmers field under organic cultivation.**

Course Outcome

CO1: The students will be able to recommend suitable organic package of practices for enhanced production of vegetable crops.

CO2: They will be able to establish various organic input production units.

CO - PSO - PO Mapping

	PSO1	PSO2	PSO3	PSO4	PO1	PO2	PO3	PO4	PO5	PO6
CO1	X	X	X	X	X	X	X	X	X	X
CO2	X	X	X	X	X	X	X	X	X	X

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VSC 624 PRINCIPLES AND PROCESSING OF VEGETABLE CROPS (2+1)

Learning Objectives

- To educate principles and practices of processing of vegetable crops.
- To understand post harvest physiology and recent advances carried out in processing of vegetable crops.

Theory

Unit I Post harvest technology scenario of vegetable crops

History of food preservation- present status and future prospects of vegetable preservation industry in India- harvest indices- harvesting methods- harvesting practices for specific market requirements- influence of pre harvest factors on post harvest quality and shelf life of horticultural crops- factors leading to post harvest technology.

Unit II Role of microorganisms in food preservation

Role of microorganisms in food preservation- spoilage of fresh and processed horticultural produce; biochemical changes and enzymes associated with spoilage of horticultural produce; principal spoilage organisms- food poisoning and their control measures.

Unit III Stroage methods and processing

Storage methods *viz.*- ventilated- refrigerated- MAS- CAS- physical injuries and disorders during storage- raw materials for processing- primary and minimal processing; processing equipments- nutritionally enriched / fortified products- layout and establishment of processing industry- BIS- AGMARK- Codex Alimentarius – fruit products order (FPO)- FPO licence- importance of hygiene and plant sanitation.

Unit IV Packaging technologies and quality control

Packaging technologies- packaging materials and transport- quality assurance and quality control- TQM- GMP- food standards - FPO- PFA- etc.- food laws and regulation- food safety- hazard analysis and critical control points (HACCP)- role of NHB- APEDA- plant quarantine and other certifying agencies governing internal and foreign trade of harvested produce.

Unit V Value addition and management of wastes from processing industries

Utilization and management of waste and processing industry- labeling and labeling act- nutrition labeling- major value added products from vegetables. Utilization of by-products of vegetable processing industry- management of waste from processing factory- investment analysis-principles and methods of sensory evaluation of fresh and processed vegetables.

Current Stream of Thought

Practical

Experiments on extension of shelf life- experiments on methods of preservation- changes occurring during preservation- various methods of preservation products- study of machinery and equipments used in processing of horticultural produce- chemical analysis for nutritive value of fresh and processed vegetables- study of different types of spoilages in fresh as well as processed horticultural produce- classification and identification of spoilage organisms- study of biochemical changes and enzymes associated with spoilage- laboratory examination of vegetable products- sensory evaluation of fresh and processed vegetables- study of food standards - national- international- codex alimentarious- visit to processing units to study the layout- equipments- hygiene- sanitation and residual / waste management.

Lecture schedule

1. **Post harvest technology scenario in vegetable crops.**
2. **Harvest indices and harvesting methods.**
3. **Physical and horticultural maturity.**
4. **Harvesting practices for specific market requirements.**
5. **History of food preservation.**
6. **Influence of pre harvest factors on post harvest quality and shelf life of horticultural crops,**
7. **Factors leading to post harvest technology.**
8. **Irradiation technology.**
9. **Development of new and innovative products in vegetables.**
10. **Vegetable extracts and powder for global trading.**
11. **Vegetable flavors, essence aromatics and pigments.**
12. **Present status and future prospects of vegetable preservation industry in India.**
13. **Pre-cooling, treatments prior to transport.**
14. **Role of microorganisms in food preservation- spoilage of fresh and processed horticultural produce.**
15. **Biochemical changes and enzymes associated with spoilage of horticultural produce- principal spoilage organisms, food poisoning and their control measures.**
16. **Stroage methods** *viz.,* **ventilated and refrigerated.**
17. **Mid-semester examination**
18. **Modified Atmospheric storage (MAS).**
19. **Controlled atmospheric Storage (CAS).**
20. **Storage consideration temperature, humidity, atmospheric composition etc.**
21. **Physical injuries and disorders during storage.**
22. **Raw materials for processing.**
23. **Primary and minimal processing of vegetable crops.**
24. **Processing equipments; nutritionally enriched / fortified products.**
25. **Layout and establishment of processing industry, FPO licence. Importance of hygiene- plant sanitation.**
26. **Packaging technologies, packaging materials and transport by products from processing and its management.**
27. **Quality assurance and quality control, TQM, GMP.**
28. **BIS, AGMARK, Codex Alimentarius –food standards FPO, PFA, etc.**
29. **Food laws and regulation- food safety- hazard analysis and critical control points (HACCP).**
30. **Role of NHB, APEDA- plant quarantine and other certifying agencies governing internal and foreign trade of harvested produce.**
31. **Labeling and labeling act, nutrition labeling.**
32. **Major value added products from vegetables.**
33. **Utilization of byproducts of vegetable processing industry- Management of waste from processing factory- investment analysis.**
34. **Principles and methods of sensory evaluation of fresh and processed vegetables.**

Practical schedule

1. **Exercise on harvesting of fruit based on maturity indices.**
2. **Pre-cooling, grading, washing and waxing treatments.**
3. **Collection and practicing usage of various packaging materials.**
4. **Experiments to hasten ripening of fruits.**
5. **Experiments on extension of self life vegetable crops.**
6. **Practice in judging the maturity of vegetable crops**
7. **Experiments on methods of preservation, changes occurring during preservation.**
8. **Study of machinery and equipments used in processing of horticultural produce.**
9. **Preparation of sauce and ketchup.**
10. **Preparation of brine and syrup for preservation.**
11. **Preparation of pickles.**
12. **Preparation of value added products from vegetables.**

13. **Chemical analysis for nutritive value of fresh and processed vegetables.**
14. **Sensory evaluation of fresh and processed vegetables.**
15. **Study of food standards. National, international standards.**
16. **Visit to processing units, to study the layout, equipments, hygiene, sanitation and residual / waste management.**
17. **Project preparation to establish processing industry.**

Course Outcome

CO1: The students will be able to demonstrate different methods of processing of vegetable crops

CO2: They will be able to prepare a proposal for establishing a vegetable processing unit.

CO - PSO - PO Mapping

	PSO1	PSO2	PSO3	PSO4	PO1	PO2	PO3	PO4	PO5	PO6
CO1	X	X	X	X	X	X		X	X	
CO2	X	X	X	X	X	X		X	X	

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OPC- HOR 711 PROPAGATION AND NURSERY MANAGEMENT OF HORTICULTURAL CROPS (2+1)

Learning Objectives

- **To make the students learn different methods of plant propagation.**
- **To impart knowledge on nursery management of various horticultural crops.**
- **To make them familiarize with the tools and implements essential for all horticultural operations**

Theory

Unit I Principles of plant propagation

Sexual and asexual methods of propagation - principles and factors influencing seed germination-dormancy- hormonal regulation of germination and seedling growth- seed quality- packing- storage- certification and testing.

Unit II Anatomical and physiological aspects of plant propagation

Techniques of cottage - layerage- graftage and budding- compatibility- dwarfing rootstocks of important fruit trees.

Unit III Plant growth regulators and plant tissue culture

Role of PGR'S in plant propagation- role of nucellar embryony- apomixes- tissue culture techniques- hardening techniques .

Unit IV Planning of a nursery unit and modern propagation structures

Raising of nursery plants- selection- certification maintenance of mother plants and bud wood and root stock nurseries- use of modern structures- mist chambers- low cost poly houses- tunnel houses.

Unit V Marketing methods of nursery plants and economics

Media/soil mixtures- containers- use of machinaries- lifting- packing- transport- marketing- economics of raising nursery and management in different fruit crops.

Current Stream of Thought

Practical

Media/soil mixture- containers and soil sterilisation- use of chemicals for seed treatment and sowing- preparation of nursery beds- polybags- seedpans- thumb rule for raising seedlings- stratification and scarification of seeds and use of tetrazolium salts for germination tests-identification of nucellar seedlings- practice of different asexual methods of propagation- viz.-cuttage- layering- budding- approach- veneer and softwood grafting-use of plant growth regulators in propagation of plants -use of mist chambers- modern propagation structures- low cost polyhouses- low tunnels and bottom heating techniques- selection- lifting- packing- transportation and marketing of nursery plants- economics of raising nurseries- visit to local commercial/private nurseries.

Lecture schedule

1. **Scope and importance of plant propagation.**
2. **Study of sexual and asexual methods of propagation.**
3. **Advantages and disadvantages of seed and vegetative propagation.**
4. **Factors influencing seed germination of Horticultural crops.**
5. **Studies on dormancy, hormonal regulation of germination and seedling growth.**
6. **Study of seed quality, packing, storage, certification and testing.**
7. **Study of anatomical and physiological aspects of asexual propagation.**
8. **Studies on graft compatibility on fruit crops.**
9. **Dwarfing rootstocks of commercial importance in fruit crops.**
10. **Role of PGR's in raising seedlings and rooting of cuttings and layers.**
11. **Role of nucellar embryony and apomixis.**
12. **Studies on tissue culture techniques.**
13. **Micro grafting (STG).**
14. **Techniques of cuttings and layering.**
15. **Techniques of budding and grafting.**
16. **Planning of nursery unit.**
17. **Mid-semester examination**
18. **Study of raising of nursery plants and their after care- role of protray nursery and their after care.**
19. **Study of modern propagation structures.**
20. **Role of mist chambers in plant propagation.**
21. **Study of bottom heating techniques.**
22. **Hardening techniques in nursery.**
23. **Progeny orchard and scion bank.**
24. **Establishment of bud wood bank.**
25. **Media -soil mixture preparation for nursery plants.**
26. **Study of containers used for nursery.**
27. **Use of machineries in nurseries.**
28. **Soil sterilization techniques.**
29. **Irrigation systems in nursery plants.**

30. Lifting and packing of nursery plants.
31. Transportation and marketing of nursery plants.
32. Nursery planning and layout .
33. Economics of raising nursery and management of different fruit crops.
34. Nursery acts.

Practical schedule

1. Media/soil mixture, containers and soil sterilization.
2. Use of chemicals for seed treatment and sowing.
3. Preparation of nursery beds, polybags, seedpans, thumbrule for raising seedlings.
4. Stratification and scarification of seeds and use of tetrazolium salts for germination.
5. Identification of nucellar seedlings.
6. Practice of different asexual methods of propagation, viz.,cuttage, layering.
7. Buddingmethods.
8. Grafting- methods.
9. Use of plant growth regulators in propagation.
10. Role of mist chambers in plant propagation.
11. Other protected structures uses for plant propagation.
12. Low cost polyhouses, low tunnels.
13. Bottom heating techniques and soil sterilization.
14. Selection, lifting, packing of nursery plants.
15. Transportation and marketing of nursery plants.
16. Economics of raising nurseries.
17. Visit to local commercial/private nurseries.

Course Outcome

CO1- gain knowledge on physiology, principles, factors influencing, media and methods of propagation of Horticultural crops

CO2-gain skill in all propagation methods and technology for commercial scale adoption

CO3- become capable of managing commercial nursery business.

CO - PSO - PO Mapping

	PSO1	PSO2	PSO3	PSO4	PO1	PO2	PO3	PO4	PO5	PO6
CO1	X		X	X	X	X	X	X	X	X
CO2	X		X	X	X	X	X	X	X	X
CO3	X		X	X	X	X	X	X	X	X

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OPC VSC 712# HI - TECH VEGETABLE PRODUCTION (2+1)

Learning Objectives

- **To teach hi- tech cultivation of vegetable crops under protected conditions.**
- **To impart knowledge on recent advances made in growing of vegetable crops under protected environmental conditions.**

Theory

Unit I Importance, scope and principles of Hi-tech vegetable production

Importance and scope of protected cultivation of vegetable crops. principles used in protected cultivation- energy management- low cost structure- training methods- engineering aspects.

Unit II Environmental factors and its manipulation for vegetable production

Types of green house- poly house/ net house hot- cold framers- effect of environmental factors viz temp- light - co_2 and humidity on growth of different vegetables- manipulation of co_2- and temperature for vegetable production.

Unit III Green house media- containers- heating and cooling systems

Growing media and sterilization- soilless cultivation- hydro-ponics and aero ponics- types of benches and containers irrigation and fertigation- green house environmental control systems- cooling system- heating system light and photo period manipulation.

Unit IV Techniques of raising vegetables in protected structures

Regulation of flowering and fruting in vegetable crops. technology for raising tomato- sweet pepper- cucumber and other vegetables in protected structures- training and staking in protected crops- varieties and hybrids for growing vegetables in protected structures.

Unit V Problems and remedies in Hi-tech cultivation

Problem of growing vegetables in protected structures and their remedies- insect and disease management in protected structures- soil-less culture- use of protected structures for seed production.

Current Stream of Thought

Practical

Study of different protected structures- cladding materials used- installation and their management study of environment control devices used in protected structures measurement of temperature- RH- light and CO_2 study of growing media and sterilization- study of irrigation and fertigation systems and their management- soilless cultivation- hydroponics and aeroponics- control of insect pest and disease in green house -working out economics of protected cultivation visit to established green/poly house/net/shade house in the region.

Lecture schedule

1. **History of protected cultivation of vegetables and its scope in India.**
2. **Present status of Hi-tech cultivation and its importance.**
3. **Principles involved in Hi-tech vegetable cultivation.**
4. **Modes of protected cultivation.**
5. **Nursery raising in protected structures.**
6. **Low – cost protected structures.**
7. **Site selection, structural designs, styles single span, multi-spa.n**
8. **Effect of environmental factors on the growth of vegetables.**
9. **Manipulation of CO_2, light and temperature for vegetable production**
10. **Green house roofing materials.**
11. **Green house media, natural and synthetic and sterilization.**
12. **Soilless cultivation, Hydroponics and Aeroponics.**
13. **Green house beds and benches construction and space use efficiency.**
14. **Green house temperature control, heating, cooling and lighting.**
15. **Cooling methods, ventilations, evaporative cooling and air conditioning.**
16. **Types of irrigation in green house, purpose and advantage.**
17. **Mid-semester examination.**
18. **Fertigation of vegetable crops under protected cultivation.**

19. Pruning of vegetable crops under protected structure.
20. Training, staking and other operations under Hi-tech vegetable production.
21. Regulation of flowering and fruiting of vegetable crops.
22. Hi tech production of tomato.
23. Hi tech production of sweet pepper.
24. HI tech production of cucumber and other vegetables.
25. Hi tech production of exotic vegetables.
26. Suitable varieties and hybrids for growing vegetables in protected structures.
27. Problems in Hi-tech cultivation and remedies.
28. Insect and disease management in protected structures.
29. Use of protected structures for seed production.
30. Precision Horticulture, principles and concepts.
31. GPS, GIS remote sensing sensors.
32. Variability management in precision farming, mapping, variable rate technology.
33. Precision equipments, computers and robotics in precision farming.
34. Cost – economics of Hi-tech vegetable production.

Practical schedule

1. Study of various modes of protected cultivation.
2. Study of environment control devices used in protected structures.
3. Study of growing media and sterilization.
4. Study of irrigation and Fertigation systems.
5. Study of soilless cultivation, Hydroponics and Aeroponics.
6. Estimating the cost of low cost green house of IARI model.
7. Designing of covering materials.
8. Designing of cooling systems.
9. Designing of irrigation system.
10. Control of insect pest and disease in green house.
11. Economics of green house cultivation of tomato.
12. Economics of green house cultivation of sweet pepper.
13. Economics of green house cultivation of cucumber.
14. Visit to established green/poly house/ net/ shade house in the region.
15. Visit to export oriented vegetable units.
16. Visit to precision farming unit.
17. Visit to GPS, GIS and remote sensing facility.

Course Outcome

CO1:The students will be able to demonstrate working principles of protected cultivation.

CO2: The students will be able to establish and manage Hi-Tech vegetable production units.

CO - PSO - PO Mapping

	PSO1	PSO2	PSO3	PSO4	PO1	PO2	PO3	PO4	PO5	PO6
CO1	X	X	X	X	X	X	X	X	X	X
CO2	X	X	X	X	X	X	X	X	X	X

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DEPARTMENT OF HORTICULTURE

GHOR 23 - M.Sc. (HORTICULTURE) IN FLORICULTURE AND LANDSCAPE ARCHITECTURE

Programme Outcome:

Any post graduate from the Faculty of Agriculture will

PO1.have core knowledge leading to awareness on advancements in the field of agriculture and horticulture including crop production, soil fertility, crop protection, crop improvement, microbiology, bio technology, agricultural extension and economics.

PO2.have basic understanding and skill on experimental tools in biological sciences, analytical techniques for plant and soil samples, microbial technologies, biotechnological tools, breeding methods, statistical tools & analysis, research data computation, etc, required for higher learning, research and development.

PO3.be mastering the modern agronomic techniques of crop production, water, soil & nutrient management, plant protection with respect to insect pest and plant diseases , crop improvement and ecosystem restoration.

PO4.will be able to design and execute individual research project, write concise & persuasive research articles and communicate effectively with their scientific colleagues, farmers and the general public.

PO5.be able to communicate research and educational materials properly and competently and

PO6.be able to address complex problems taking into account related ethical, social, legal, economic, and environmental issues.

Programme Specific Outcome

PSO1- The student will acquire knowledge on crop improvement, production technologies, and post harvest technologies pertaining to floriculture.

PSO2- Will gain skill in landscape designing, plan execution and project management.

PSO3-Student will be able to do individual research in floriculture

PSO4-The student will become eligible to work in Floriculture projects, landscape industries, town planning, environmental and floricultural research projects, etc.

GHOR 23 M.Sc. (HORTICULTURE) IN FLORICULTURE AND LANDSCAPE ARCHITECTURE

DISTRIBUTION OF COURSES

S. No.	Course Code	Course Title	Credit Hours
		Major courses	
1.	FLA 611	Breeding of flower crops and ornamental plants	2+1
2.	FLA 612	Production technology of loose flowers	2+1
3.	FLA 613	Production technology of cut flowers	2+1
4.	HOR 621 HOR 622	Growth regulation and stress management in horticultural crops (or) Protected and precision horticulture	2+1
5.	FLA 621	Ornamental and landscape gardening	2+1
6.	FLA 622 FLA 623	CAD for outdoor and indoor scaping (or) Value addition in flowers	1+1
7.	FLA 624	Turfing and turf management	2+1
			13+7=20
	FLA 011/021/031/041	Research(0+1)+(0+2)+(0+8)+(0+9)	0+20
	FLA 032	Seminar	0+1
		Minor course	
1.	OPC-CRP 621	Concepts of crop physiology	2+1
2.	OPC-XXX	Minor course from other departments /related disciplines	2+1
3.	OPC-XXX	Minor course from other departments /related disciplines	2+1
			6+3=9
		Supporting courses	
1.	STA 611	Statistical methods and design of experiments	2+1
2.	COM 611	Computer applications for agricultural research	1+1
			3+2=5
		Non - credit compulsory courses	
1.	PGS 611	Agricultural research ethics and methodology	0+1
2.	PGS 612	Technical writing and communication skills	0+1
3.	PGS 623	Basic concepts in laboratory techniques	0+1
4.	PGS 624	Library and information services	0+1
5.	PGS 715*	Intellectual property rights and its management in agriculture	1+0
6.	PGS 716*	Disaster management	1+0
			2+4=6

*** e-course**

GHOR 23 M.Sc. (HORTICULTURE) IN FLORICULTURE AND LANDSCAPE ARCHITECTURE

SEMESTER WISE DISTRIBUTION OF COURSES

SEMESTER I			
S. No.	**Course Code**	**Course Title**	**Credit Hours**
1.	FLA 611	Breeding of flower crops and ornamental plants	2+1
2.	FLA 612	Production technology of loose flowers	2+1
3.	FLA 613	Production technology of cut flowers	2+1
4.	STA 611	Statistical methods and design of experiments	2+1
5.	COM 611	Computer applications for agricultural research	1+1
6.	FLA 011	Research(0+1)+(0+2)+(0+8)+(0+9)	0+1
7.	PGS 611	Agricultural research ethics and methodology *	0+1
8.	PGS 612	Technical writing and communication skills *	0+1

SEMESTER-II			
S. No.	**Course Code**	**Course Title**	**Credit Hours**
1.	HOR 621 HOR 622	Growth regulation and stress management in horticultural crops (or) Protected and precision horticulture	2+1
2.	FLA 621	Ornamental and landscape gardening	2+1
3.	FLA 622 FLA 623	CAD for outdoor and indoor scaping (or) Value addition in flowers	1+1
4.	FLA 624	Turfing and turf management	2+1
5.	FLA 021	Research	0+2
6.	OPC-GPB 621	Concepts of crop physiology	2+1
7	PGS 623	Basic concepts in laboratory techniques*	0+1
8	PGS 624	Library and information services *	0+1

Semester-III			
S. No.	**Course Code**	**Course Title**	**Credit Hours**
1.	**OPC-XXX**	**Minor course from other departments /related disciplines**	**2+1**
2.	**OPC-XXX**	**Minor course from other departments /related disciplines**	**2+1**
	OPC-HOR 711#	**Propagation and nursery management of horticultural crops**	**2+1**
	OPC-FLA 712#	**Ornamental horticulture**	**2+1**
3.	**FLA 031**	**Research**	**0+8**
4.	**FLA 032**	**Seminar**	**0+1**
5.	**PGS 715**	**Intellectual property rights and its management in agriculture ***	**1+0**
6.	**PGS 716**	**Disaster management ***	**1+0**
7.	**PGS 717**	**Constitution of India ***	**1+0**

Semester-IV			
S. No.	**Course Code**	**Course Title**	**Credit Hours**
1.	**FLA 041**	**Research**	**0+9**
2.	**VASC**	**Value added course***	**3+0**

#-Optional course offered to other departments/discipline only

***Non – credit Compulsory course**

ABSTRACT

Course	**Semester wise credit distribution**				**Total**
	I	**II**	**III**	**IV**	
Major	**9**	**11**	**-**	**-**	**20**
Minor	**-**	**3**	**6**	**-**	**9**
Supporting	**5**	**-**	**-**	**-**	**5**
Seminar	**-**	**-**	**1**	**-**	**1**
Research	**1**	**2**	**8**	**9**	**20**
Total credits	**15**	**16**	**15**	**9**	**55**
Non-credit	**Two courses**	**Two courses**	**Three courses**	**One Course**	**Eight courses**

FLA 611 BREEDING OF FLOWER CROPS AND ORNAMENTAL PLANTS (2+1)

Learning Objectives

- **The student will gain comprehensive knowledge about the breeding methodologies, concepts and principles of breeding flower crops.**
- **Students will know about breeding techniques of commercial flower crops and ornamental plants.**
- **Students will update knowledge on IPR issues and Course Outcomes of crop improvement programmes in Indian floriculture.**
- **To impart skill in hybrid flower seed production.**

Theory

Origin- distribution- breeding principles- genetic resources- genetic divergence- genetic inheritance- evolution of varieties- breeding objectives- breeding methods- specific breeding problems and achievements- seed production- patents- plant variety protection act and IPR issues of the following crops:

Unit I Breeding of flower crops -I

Rose, jasmine, chrysanthemum, nerium and crossandra.

Unit II Breeding of flower crops -II

Tuberose, carnation, marigold, gerbera and gladiolus.

Unit III Breeding of flowers crops -III

Orchids, anthurium, dahlia and liliums.

Unit IV Breeding of annuals

Flowering annuals – zinnia, petunia, cosmos, dianthus, snap dragon, pansy, aster and petunia

Unit V Breeding of ornamental plants

Heliconia, bird of paradise, hibiscus, bougainvillea and other foliages- breeding of ornamental plants for waterscaping and xeriscaping.

Current Stream of Thought

Practical

Description of botanical features, cataloguing of cultivars, varieties and species in flower crops, floral biology, practices in hybridization, evaluation of hybrid progenies, induction of polyploidy, induction of mutants through physical and chemical mutagens, screening for resistance against biotic and abiotic stress and environmental pollution, *in-vitro* breeding in flower crops and ornamental plants, seed production techniques in flowering annuals, visit to organizations working on breeding of flower crops and ornamental plants.

Lecture schedule

Origin, distribution, breeding principles,genetic resources,genetic divergence,genetic inheritance,evolution of varieties, breeding objectives, breeding methods, specific breeding problems and achievements of the following crops:

1-3. Rose
4-6. Jasmine.
7-9. Chrysanthemum.
10. Crossandra.
11-12. Tuberose.
13. Carnation.
14. Marigold.
15. Gerbera
16. Gladiolus
17. Mid- semester examination.
18. Orchids.
19. Anthurium
20. Dahlia
21. Nerium
22. Zinnia
23. Cosmos
24. Dianthus

25. Snapdragon
26. Pansy and petunia
27. Aster
28. Petunia
29. Lilium
30. Heliconia and bird of paradise
31. Hibiscus
32. Bougainvillea and other foliages
33. Patents and Plant Variety Protection Act and IPR issues.
34. Breeding of ornamental plants for waterscaping and xeriscaping.

Practical schedule

1. **Cataloguing of cultivars, varieties and species of rose, jasmine and chrysanthemum.**
2. **Cataloguing of cultivars, varieties and species of marigold, tuberose and crossandra.**
3. **Cataloguing of cultivars, varieties and species of orchids, anthurium and gerbera.**
4. **Cataloguing of cultivars, varieties and species of carnation and gladioli.**
5. **Study of floral biology of flower crops.**
6. **Study of pollen production and fertility.**
7. **Practices in hybridization of flower crops.**
8. **Evaluation of hybrid progenies.**
9. **Experiments on hybrid seed production in flower crops.**
10. **Practices in ploidy breeding in flower crops.**
11. **Practices in induction of mutation in flower crops.**
12. **Practices in** *in vitro* **breeding of flower crops and ornamental plants.**
13. **Seed production techniques in flowering annuals.**
14. **Screening of plants for resistance against biotic stress.**
15. **Screening of plants for resistance against abiotic stress.**
16. **Screening of plants for resistance against environmental pollution.**
17. **Visit to Research Institutions working on improvement of flower crops, commercial flower breeding / seed production centres.**

Course Outcome

CO1- The students must be able to demonstrate different breeding techniques in flower crops.
CO2 - The students will become capable of working on breeding programmes in flower crops.
CO3- Will get insights into IPR issues and hybrid seed production in commercial flower crops.

CO - PSO - PO Mapping

	PSO1	PSO2	PSO3	PSO4	PO1	PO2	PO3	PO4	PO5	PO6
CO1	X		X	X	X	X	X	X	X	X
CO2	X		X	X	X	X	X	X	X	X
CO3	X		X	X	X	X	X	X	X	X

References

1. **Arora, J.S. 2012. Introductory Ornamental Horticulture. Kalyani Publ. New Delhi.**
2. **Bhattacharjee, S.K. 2006. Advances in Ornamental Horticulture. Vols. I-VI. Pointer Publ. New Delhi**
3. **Choudhary, R.C. 1993. Introduction to Plant Breeding. Oxford & IBH.**
4. **Bose, T.K. and L.P. Yadav. 1989. Commercial Flowers. NayaProkash. Kolkatta**
5. **Chadha, K.L. and B. Choudhury. 1992. Ornamental Horticulture in India. ICAR, New Delhi**
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FLA 612 PRODUCTION TECHNOLOGY OF LOOSE FLOWERS (2+1)

Learning Objectives

- Students will grasp the knowledge on production problems in loose flowers.
- The student will gain basic knowledge about the production technologies of loose flowers in Indian context.
- Students will study the concepts and principles behind the hi-tech production of loose flowers and flower forcing techniques

Objectives

To impart basic knowledge about the importance and production technology of loose flowers in India.

Theory

Scope and importance of loose flower trade- significance in the domestic /export market- Institutional support- agri export zones- floricultural enterprises- varietal wealth and diversity- Area under loose flowers and production problems in india- soil and climate requirements- special nursery techniques- field preparation- systems of planting- transplanting techniques- water and nutrient management- weed management- training and pruning- special horticultural practices- inter cultural operations- growth regulators - use of growth regulators- chemicals flower forcing and year round flowering- precision farming techniques- production for special occasions through physiological interventions- pest and disease management-physiological disorders and remedies- harvest indices and harvesting techniques of the following crops:

Unit I: Production technology of loose flower crops -I

Jasmine, rose, tuberose and marigold

Unit II Production technology of loose flower crops- II

Chrysanthemum,crossandra, celosia, barleria, gaillardia.

Unit III Production technology of loose flower crops -III

Nerium, gomphrena, lotus, champaka, Ixora,

Unit IV: Production technology of loose flower crops -IV

Nyctanthes, tabernaemontana, tecoma, hibiscus and pandanus.

Unit V Post harvest technology and value addition in loose flower crops

Post-harvest handling- packing and storage- transportation and marketing- prospects of value addition- value addition in loose flowers (garlands- veni- floats- floral decorations- etc.) and extensions of shelf life- dry flowers- techniques in dry flower making- concrete and essential oil extraction methods.

Current Stream of Thought

Practical

Description of species and varieties- propagation techniques- training and pruning techniques- practices in manuring- foliar nutrition- growth regulator application- pinching- disbudding- staking- harvesting techniques- post-harvest handling- storage and cold chain- project preparation for regionally important commercial loose flowers- visit to fields- essential oil extraction units and markets.

Lecture schedule

1. Scope and importance of loose flowers, scenario of global and national loose flower production
2. Export potential, institutional support
3. Agri Export Zones, floricultural enterprises
4. Production constraints in loose flowers

Varietal wealth, soil and climate requirements, special nursery techniques, field preparation, systems of planting, transplanting techniques, water and nutrient management, weed management, training and pruning, special horticultural practices, pinching, disbudding, use of growth regulators, flower forcing and year round flowering, precision farming techniques, production for special occasions through physiological interventions, chemical regulation, integrated pest management and integrated disease management, physiological disorders and remedies, harvest indices and harvesting techniques of the following crops:

5-6. Jasmine
7 – 9. Rose
10. Tuberose
11. Marigold
12-13. chrysanthemum
14.Crossandra
15.Celosia
16. Barleria, gaillardia
17. Mid semester examination
18.Nerium
20.Gomphrena
21.Lotus
22.Champaka
23.Ixora
24.Nyctanthes
25.Tabernaemontana
26.Tecoma
27.Gaillardia
28.Hibiscus and pandanus.
29. Post-harvest handling of loose flowers
30. Packaging and storage techniques in loose flowers
31. Prospects of value addition in loose flowers
32-33. Dry flowers
34. Concrete and essential oil extraction methods.

Practical schedule

1. **Description of varieties of jasmine, rose, chrysanthemum.**
2. **Description of varieties of marigold, tuberose, crossandra.**
3. **Propagation techniques of jasmine, chrysanthemum.**
4. **Propagation techniques of marigold, tuberose, crossandra.**
5. **Practices in pro-tray nursery and shade nets.**
6. **Training and pruning techniques in jasmine and rose.**
7. **Special Horticultural techniques in loose flowers.**
8. **Practices in manuring and fertilizer scheduling in loose flowers.**
9. **Practices in foliar nutrition in loose flowers.**
10. **Practices in growth regulator application in loose flowers**
11. **Diagnosis of physiological and nutritional disorders and remedial measures in loose flowers.**
12. **Maturity and harvesting standards**
13. **Packaging techniques in loose flowers.**
14. **Experiments on dry flower making and essential oil extraction.**
15. **Visit to dry flower units.**
16. **Visit to concrete and essential oil extraction units.**
17. **Project preparation on commercial loose flower production with cost-benefit analysis.**

Course Outcome

CO1- The student will have knowledge on advanced production technologies in growing flower crops.

CO2 - The students will be able to diagnose production problems in loose flowers.

CO3- The students will become capable of managing a open field floriculture unit from planting to harvest.

CO - PSO - PO Mapping

	PSO1	PSO2	PSO3	PSO4	PO1	PO2	PO3	PO4	PO5	PO6
CO1	X		X	X	X	X	X	X	X	X
CO2	X		X	X	X	X	X	X	X	X
CO3	X		X	X	X	X	X	X	X	X

References

1. **Bhattacharjee, S.K. 2006. Advances in Ornamental Horticulture. Vols. 1-VI. Pointer Publ., Jaipur.**
2. **Bose, T.K., L.P. Yadav, P. Pal, P. Das. and V.A. Parthasarathy. (Eds.) 2002 and 2003. Commercial Flowers, Vol. I and II. Second Revised Edition. NayaUdyog, Kolkata.**
3. **Bose, T.K., R.G. Maiti, R.S. Dhua. and P. Das. 1999. Floriculture and Landscaping. NayaProkash, Kolkata**
4. **Chadha, K.L. 1986. Ornamental Horticulture in India ICAR, KrishiBhavan, New Delhi.**
5. **Chadha, K.L. and B. Chaudhury. 1992. Ornamental Horticulture in India ICAR KrishiBhavan, New Delhi.**
6. **Chadha, K.L. and S.K. Bhattacharjee. 1995. Advances in Horticulture Vol.12. Ornamental Plants (eds.). Malhotra Publishing House, New Delhi, India.**
7. **Larsen, R.A. 1981. Introduction to Floriculture. Academic Press, New York.**
8. **Lauria, A. and V.H. Ries. 2001. Floriculture – Fundamentals and Practices, Agrobios, Jodhpur.**
9. **Prasad, S. and U.Kumar. 2003. Commercial Floriculture. Agrobios, Jodhpur.**
10. **Reddy, S., B. Janakiram, T. Balaji, S. Kulkani and R.I. Misra. 2007. High tech Floriculture. Indian Society of Ornamental Horticulture, New Delhi.**
11. **Sheela, V.L. 2007. Flowers in Trade, New India Publ. Agency, New Delhi.**

FLA 613 PRODUCTION TECHNOLOGY OF CUT FLOWERS (2+1)

Learning Objectives

- **Students will learn advances in production technologies of cut flowers in global context.**
- **The student will gain basic knowledge about the production technologies of cut flowers for Indian and export market.**
- **Students will study the concepts and principles behind the hi-tech production of cut flowers.**

Objectives

To impart basic knowledge about the importance and production technology of cut flowers in India.

Theory

Scope of cut flowers in global trade- global and national scenario of cut flower production- area under cut flowers and production problems in india- export potential- Institutional support- agri export zones- varietal wealth and diversity- nursery management- open cultivation- protected cultivation- influence of environmental parameters- light- temperature- moisture- humidity and CO_2 on growth and flowering- growing media- soil decontamination techniques- planting methods- water and nutrient management- fertigation- weed management- training and pruning- special horticultural practices growth regulation- use of growth regulators-flower forcing- year round flowering through physiological interventions-

chemical regulation- environmental manipulation- physiological disorders and remedies- production for exhibition purposes- harvest indices and harvesting techniques, standards and grades- post-harvest handling methods of the following crops:

Unit I Production technology of cut flowers- I

Rose, chrysanthemum and Orchids

Unit II Production technology of cut flowers- II

Carnation, gerbera, and anthurium

Unit III Production technology of cut flowers- III

Lilium gladiolus, alstroemeria dahlia, bird of paradise, heliconia,

Unit IV Production technology of cut flowers - IV

China aster, gypsophilla, golden rod and lisianthus.

Unit V Production technology of cut flowers - V

Limonium, ornamental, ginger, bromeliads and cut foliages.

Current Stream of Thought

Practical

Description of varieties- propagation techniques- layout of drip and fertigation system- training and pruning techniques- practices in manuring- fertilizer scheduling- foliar nutrition- growth regulator application- special horticultural practices- diagnosis of physiological and nutritional disorders and control measures- maturity and harvesting standards- practices in post harvest handling- project preparation on commercial cut flower production with cost-benefit analysis.

Lecture schedule

1. Scope and importance of cut flowers, scenario of global and national cut flower production.

2. Export potential and production problems in India, Institutional support, Agri Export Zones.

Varietal wealth and diversity, nursery management, open cultivation, protected cultivation, influence of environmental parameters, light, temperature, moisture, humidity and CO_2 on growth and flowering, growing media, soil decontamination techniques, planting methods, water and nutrient management, fertigation, weed management, training and pruning, special horticultural practices, use of growth regulators, flower forcing, year round flowering through physiological interventions, chemical regulation, environmental manipulation, physiological disorders and remedies, production for exhibition purposes, harvest indices and harvesting techniques of the following crops:

3 -4. Rose.

5-6.Chrysanthemum

7-8. Tuberose

9. Bird of Paradise

10-11.Carnation

12. Gerbera

13 -14.Anthurium

15-16. Lilium

17. Mid- semester examination

18-19. Orchids

20. Gladiolus

21. Dahlia

22. Heliconia

23. Gypsophila.

24. China aster

25. Alstroemeria

26. Golden rod

27. Lisianthus
28. Limonium
29. Ornamental ginger and bromeliads
30. Cut foliages
31. Cut flower standards and grades
32-33. Post-harvest handling, methods of delaying flower opening, pre-cooling, pulsing.
34. Value addition in cut flowers.

Practical schedule

1. **Study of varieties of rose, chrysanthemum, carnation and gerbera.**
2. **Study of varieties of gladiolus, anthurium and orchids.**
3. **Propagation techniques of rose, chrysanthemum, carnation and gerbera.**
4. **Propagation techniques of gladiolus, anthurium and orchids.**
5. **Propagation techniques of open field cut flowers.**
6. **Practices in fumigation techniques, field and bed preparation in the green house.**
7. **Practices in layout of drip and fertigation systems.**
8. **Practices in manuring and fertilizer scheduling in cut flowers.**
9. **Practices in foliar nutrition and growth regulator application in cut flowers.**
10. **Practices in special horticultural techniques in rose, chrysanthemum, carnation and gerbera.**
11. **Practices in special horticultural techniques in gladiolus, anthurium and orchids.**
12. **Practices in special horticultural techniques in open field cut flowers.**
13. **Diagnosis of physiological and nutritional disorders and remedial measures in cut flowers.**
14. **Maturity and harvesting standards and packaging techniques in cut flowers.**
15. **Project preparation on commercial cut flower production with cost-benefit analysis.**
16. **Studies on post harvest handling of cut flowers.**

Visit to hi-tech flower production units

Course Outcome

CO1- The student will have knowledge on advanced production technologies in growing cut flower crops.
CO2 - The students will be able to diagnose production problems in cut flowers.
CO3- The students will become capable of managing a floriculture unit from planting to harvest.

CO - PSO - PO Mapping

	PSO1	PSO2	PSO3	PSO4	PO1	PO2	PO3	PO4	PO5	PO6
CO1	X		X	X	X	X	X	X	X	X
CO2	X		X	X	X	X	X	X	X	X
CO3	X		X	X	X	X	X	X	X	X

References

1. **Bose, T.K. and L.P. Yadav. 1989. Commercial Flowers. Naya Prokash, Kolkatta**
2. **Bose, T.K., R.G. Maiti, R.S. Dhua and P. Das. 1999. Floriculture and Landscaping. Naya Prokash, Kolkatta**
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4. **Chadha, K.L. and S.K. Bhattacharjee. 1995. Advances in Horticulture Vol.12-Ornamental plants (eds.). Malhotra Publishing House, New Delhi.**
5. **Larsen, R.A. 1981. Introduction to Floriculture. Academic Press, New York.**
6. **Lauria, A. and V.H. Ries. 2001. Floriculture-Fundamentals and Practices, Agrobios Jodhpur.**
7. **Prasad, S. and U.Kumar. 2003. Commercial Floriculture. Agrobios, Jodhpur.**

8. Reddy, S., B. Janakiram, T. Balaji, S. Kulkani and R.I. Misra. 2007. High tech Floriculture. Indian Society of Ornamental Horticulture, New Delhi.
9. Sheela, V.L. 2007. Flowers in Trade, New India Publ. Agency, New Delhi.

FLA 621 ORNAMENTAL AND LANDSCAPE GARDENING (2+1)

Learning Objectives

- To educate the students on landscape designing principles and execution of design.
- To understand about gardening concepts, styles and components.
- To learn the landscape designing process and execution of design.
- To learn about establishment and management of landscape project.

Objectives

To make on-site analysis, designing with garden elements and principles manually and using softwares.

Theory

Unit I Ornamental gardening -history and principles

Ornamental and landscape horticulture-definitions- scope and oppurtunities in landscape industry- history of landscape gardening- types of garden - bio-aesthetic planning- horticultural therapy- psychological and social aspects of ornamental plants- basic principles of gardening- beauty components- colour concept- grouping concepts.

Unit II Softscape elements in the garden

Softscape elements (living components)- basic function and utility- their culture- training and pruning- special techniques in softscaping- transplanting of container grown plants- burlapping- tree transplanting- living components for different situation- house plants- interior scaping - concepts and components.

Unit III Hardscape elements in the garden

Hardscape elements (non-living components)- construction and maintenance-basic function and utility- establishment and maintenance of special types of garden- water garden- floating plants- oxygenerating plants- rock garden- bog garden- vertical garden- roof garden- xeriscaping- bonsai- plants for bonsai- methods of bonsai culture- terrarium- flower arrangement and other horticultural crafts.

Unit IV Designing landscape gardens

Site analysis- cliental preference- home- institute- industrial garden- public parks- amusements and theme parks- landscape drawing- fundamentals of manual drawing- scale- symbols- layout- plan view- elevation and perspective diagrams- computer software- manual and creating legends for plant and non plant components.

Unit V Irrigation and mechanization in landscaping

Irrigation requirements in landscaping-methods and technology - sprinkler- layout, pattern, nozzles and valves - drip irrigation system-design and requirements, fertigation systems, design and requirements-operation and maintenance of irrigation system-automation in landscape Irrigation, landscape tools and mechanization

Current Stream of Thought

Practical

Identification of ornamental plants and garden components- study of form- size- shape- texture- flowering season and description of trees- shrubs- flower bed- foliage bed- climbers and creeper- hedges- edges cacti- succulents- ferns and palms- evaluation of different styles of garden- turf- study of types of turf grasses- establishment- care and maintenance of turf- art of topiary- practices in planning and planting of special types of gardens- identification- planning and designing of non-living components- principles and concepts in garden designing techniques in transplanting of container grow plants- burlapping- tree transplanting- preparation of landscape plan layout- application of cad in landscape garden designing- 2D

drawing by autocad- 3D drawing by 3D max software- basics of photoshop software in garden designing- project preparation on landscape execution for home- institute- industrial- public parks and theme parks- study on horticultural crafts- bonsai- terrarium and flower arrangement- visit to parks and botanical garden.

Lecture schedule

1. Ornamental and landscape horticulture, definitions, prospects of landscape industry.
2. History of landscape gardening.
3. Types of gardens.
4. Bio-aesthetic planning, Horticultural therapy.
5. Psychological and social aspects of ornamental plants.
6. Basic principles of gardening.
7. Beauty components, colour concept, grouping concepts.
8-10.Softscape elements (living components), basic function and utility, their culture, raining and pruning.
11-12. Special techniques in softscaping, transplanting of container grown plants, burlapping, tree transplanting.
13. Living components for different situations.
14-15. House plants, interior scaping, concepts and components.
16. Hardscape elements (non-living components)
17. Mid -semester examination.
18-19. Hardscape elements - construction and maintenance, basic function and utility.
20-21. Establishment and maintenance of special types of garden, water garden floating plants oxy generating plants, rock garden, bog garden vertical garden, roof garden, xeriscaping.
22-23. Bonsai, plants for bonsai, methods of bonsai culture, terrarium, flower arrangement and other horticultural crafts.
24-25. Bonsai, plants for bonsai, methods of bonsai culture, terrarium, flower arrangement and other horticultural crafts.
26-27. Site analysis, cliental preference, home, institute, industrial garden, public parks, amusements and theme parks.
28-29. Landscape drawing, fundamentals of manual drawing, scale symbols, layout ,plan view, elevation and perspective diagrams.
30-31. Irrigation requirements in landscaping - methods and technology - sprinkler-layout, pattern, nozzles and valves.
32-33. Drip irrigation system-design and requirements, fertigation systems, design and requirements-operation and maintenance of irrigation system.
34. Automation in landscape irrigation, landscape tools and mechanization.

Practical schedule

1. Identification of ornamental plants and garden components.
2 – 3. Study of form, size, shape, texture, flowering season and description of trees, shrubs, flower bed, foliage bed, climbers and creeper, hedges, edges cacti, succulents, ferns and palms.
4. Evaluation of different styles of garden.
5. Turf - study of types of turf grasses - establishment, care and maintenance of turf.
6. Art of topiary – practices in planning and planting of special types of gardens.
7 – 8. Identification, planning and designing of non-living components.
9. Techniques in transplanting of container grown plants, burlapping, tree transplanting.
10. Principles and concepts in garden designing.
11. Manual preparation of landscape plan layout.
12. Application of CAD in landscape garden designing.

13. Creating legends for plant and non plant components using photoshop.
14. 2D drawing by AUTOCAD and 3D drawing by 3D MAX software.
15. Project preparation on landscape execution for home, institute, industrial, public parks and theme parks.
16. Study on horticultural crafts, bonsai, terrarium and flower arrangement.
17. Visit to parks and botanical garden.

Course Outcome

CO1- The student will have knowledge on fundamental gardening principles which form the basis for learning landscape architecture.
CO2 - The students will be able to identify different soft and hard landscape elements..
CO3- The students will become capable of designing a garden project and prepare the cost economics.
CO4- The students prepare garden layouts to a specific scale for big commercial projects.

CO - PSO - PO Mapping

	PSO1	PSO2	PSO3	PSO4	PO1	PO2	PO3	PO4	PO5	PO6
CO1	X	X		X	X	X	X			X
CO2		X		X	X	X				X
CO3		X		X	X	X	X			X
CO4	X	X		X	X	X	X			X

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FLA 622 CAD FOR OUTDOOR AND INDOORSCAPING (1+1)

Learning Objectives

- **Students will know about Computer Aided Designing process for outdoor and indoorscaping.**
- **Students will be exposed to AUTOCAD drawings (2D & 3D)**
- **Will learn about ARCHICAD drawing and Plan preparation for a landscape project.**

Objectives

To impart basic knowledge about the operation of Computer Aided Designing (CAD) in landscape garden designing.

Theory

Unit I Exposure to CAD (Computer Aided Designing)

Applications of CAD in landscape garden designing- 2D drawing by AutoCAD- 3D drawing - creating legends for plant and non-plant components- basics of photoshop software in garden designing.

Unit II Commands in AutoCAD

AutoCAD toolbars and icons--file handling functions- modifying tools- modifying comments- isometric drawings- perspective views, blocks-drafting objects-Lines, Arc, Eclipse, etc., Array, polylines, attributes, exploring images into realistic views.

Unit III Designing with AutoCAD with base plan

Using patterns in AutoCAD drawing- dimension concepts-base plan reading-hyperlinking- script making- using productivity tools- e-transmit file- making sample drawing for outdoor and indoor gardens

Unit IV Softwares in Landscape designing

Software handling for designing Landscape - ARCHICADD, Sketch up, Revit, Lands Design, Photoshop Maya, Lumion, Garden Planner, Dream Plan, Realtime Landscape Pro, 3D land-3D rendering,Terragen, Edificius LAND, Marshalls Garden visualize etc, Mobile apps-iScape, Pro Landscape companion etc.

Unit V Plan preparation for various sites

Basic requirements - dimensioning and detailing of designs- attribute settings of components- 3D visualization and tools for landscape preview- data management-plotting and accessories for designing- inserting picture using photoshop and Coral Draw- making sample drawing for outdoor and indoor gardens.

Current Stream of Thought

Practical

Practices in drawing- dimension concepts-base plan reading point picking methods- using tool bars and icons- using modifying tools and modifying comments- AutoCAD toolbars and icons--file handling functions- modifying tools-modifying comments- isometric drawings- perspective views isometric drawings-using productivity tools- creation of garden components -detailing and visualization tools - using photoshop package for 3D picture insertion- practicing various softwares like ARCHICADD, Sketch up, Revit, Lands Design, Photoshop Maya, Lumion, Garden Planner, Dream Plan, Realtime Landscape Pro, 3D land-3D rendering,Terragen, Edificius LAND, Marshalls Garden visualize etc, Mobile apps-iScape, Pro Landscape companion for parks- corporate- theme parks and ecotourism spots- home garden- institutional garden and special types of garden-making sample drawing for indoor gardens.

Lecture schedule

1. **Exposure to CAD (Computer Aided Designing).**
2. **Applications of CAD in landscape garden designing: 2D drawing by AUTOCAD and 3D drawing.**
3. **Creating legends for plant and non-plant components**
4. **AutoCAD toolbars and icons--file handling functions**
5. **Modifying tools- modifying comments**
6. **Isometric drawings- perspective views, blocks- drafting objects**
7. **Polylines, attributes, exploring images into realistic views**
8. **Using patterns in AutoCAD drawing- dimension concepts-base plan reading hyperlinking-**
9. **Mid -semester Examination.**
10. **Software handling for designing Landscape - ARCHICADD, Sketch up**
11. **Software handling for designing Landscape Revit, Lands Design, Photoshop Maya, Lumion**
12. **Software handling for designing Landscape -Garden Planner, Dream Plan, Realtime Landscape Pro, 3D Land**

13. 3D rendering, Terragen, Edificius LAND, Marshalls Garden visualize etc
14. Mobile apps-iScape, Pro Landscape companion etc.
15. Basic requirements - dimensioning and detailing of designs- attribute settings of components
16. Plotting and accessories for designing- inserting picture using photoshop and Coral Draw
17. Making sample drawing for outdoor and indoor gardens.

Practical schedule

1. Practices in drawing- dimension concepts.
2. Base plan reading point picking methods- using tool bars and icons- using modifying tools and modifying comments.
3. AutoCAD toolbars and icons--file handling functions- modifying tools- modifying comments.
4. Isometric drawings- perspective views isometric drawings- using productivity tools.
5. Creation of garden components -detailing and visualization tools.
6. Photoshop package for 3D picture insertion.
7. Practicing various softwares like ARCHICADD, Sketch up.
8. Practicing various softwares Revit, Lands Design.
9. Practicing various softwares -Photoshop Maya, Lumion, Garden Planner, Dream Plan, Realtime Landscape Pro.
10. Practicing various softwares -3D land-3D rendering.
11. Terragen, Edificius LAND, Marshalls Garden visualize etc.
12. Mobile apps-iScape, Pro Landscape companion.
13. Designing for parks- corporate- theme parks.
14. Designing for ecotourism spots- home garden.
15. Designing for institutional garden.
16. Designing for special types of garden-making sample drawing for indoor gardens.

Course Outcome

CO1- The student will gain skill on CAD drawing tools in landscape designing.

CO2 - The student will be able to design a garden plan with Computer Aided Designing tools.

CO3- Student will gain skill in working with ARCHICAD

CO - PSO - PO Mapping

	PSO1	PSO2	PSO3	PSO4	PO1	PO2	PO3	PO4	PO5	PO6
CO1		X	X	X				X		
CO2		X	X	X				X		
CO3		X	X	X				X		

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FLA 623 VALUE ADDITION IN FLOWERS (1+1)

Learning Objectives

- Students will understand the importance and scope of value addition in flowers.
- The student will gain knowledge on principles and practices in value addition of flowers.
- The students will learn about different flower arrangement, dry flower making, essential oils and pigment extraction procedures.

Theory

Unit I Prospects of value addition

National and global scenario- production and exports- women empowerment through value added products making- supply chain management.

Unit II Types of value added products

Value addition in loose flowers- garlands- veni- floats- floral decorations- value addition in cut flowers- flower arrangement- styles- Ikebana- morebana- free style- bouquets- button-holes- flower baskets- corsages- floral wreaths- garlands- etc- selection of containers and accessories for floral products and decorations.

Unit III Dry flowers

Identification and selection of flowers and plant parts; raw material procurement- preservation and storage- techniques in dry flower making – drying- bleaching- dyeing- embedding- pressing- accessories- designing and arrangement – dry flower baskets- bouquets- pot-pourri- wall hangings- button holes- greeting cards- wreaths- packing and storage.

Unit IV Concrete and essential oils

Selection of species and varieties (including non-conventional species)- extraction methods- packing and storage-extraction methods- applications.

Unit V Pigments

Selection of species and varieties- types of pigments- carotenoids- anthocyanin- chlorophyll- betalains- significance of natural pigments- extraction methods- applications.

Current Stream of Thought

Practical

Techniques in loose flower decoration- practices in garlands- veni and floats making with with fresh flowers -techniques and styles in cut flower arrangements- practices in preparation of bouquets in different styles-practices in preparation of button-holes and flower baskets-practices in preparation of corsages and floral wreaths-identification of plants for dry flower making- practices in dry flower making-practices preparation of dry flower baskets-practices in preparation of bouquets- pot-pourri and button holes-practices in preparation of wall hangings- wreaths-etc-practices in preparation of greeting cards- etc- skeletanizing-leaf cup making and leaf painting-packaging and storage of fresh and dry flower products- visit to dry flower units- extraction methods of concrete and essential oil- extraction methods of pigments-visit to concrete- essential oil and pigment extraction unit.

Lecture schedule

1. **National and global scenario, production and export of value addition in flowers.**
2. **Women empowerment through value added flower products making and supply chain management.**
3. **Value addition in loose flowers- garlands, veni and floats making**
4. **Value addition in loose flowers- other floral decorations through loose flowers. Value addition in cut flowers: flower arrangements.**
5. **Eastern styles of flower arrangements like Japanese art of flower arrangements like Ikebana, morebana. etc.**
6. **Western styles of flower arrangements and bouquets, button-holes and flower baskets,corsages, floral wreaths, garlands, etc.**
7. **Selection of containers and accessories for floral products and decorations.**
8. **Identification, selection of flowers and plant parts, raw material procurement, preservation and storage for dry flower making.**
9. **Mid -semester examination**
10. **Raw material procurement, preservation and storage for dry flower making and Accessories for dry flower making.**
11. **Techniques in dry flower making – drying, bleaching, dyeing and embedding, designing and arrangement**
12. **Dry flower baskets, bouquets and pot-pourri making, wall hangings, button holes,wreaths and other designs making.**

13. Skeletanising, leaf painting, leaf cup making, pressed flower arrangements like greeting cards, Packing and storage of dry flowers.
14. Selection of species and varieties of flowers for concrete and essential oils and their significance.
15. Non-conventional species for concrete and essential oil, extraction methods and their applications.
16. Packing, storage, types of pigments-carotenoids, anthocyanin, chlorophyll and betalains.
17. Significance of natural pigments, selection of species and varieties for pigment extraction and extraction methods and applications.

Practical schedule

1. Techniques in loose flower decoration.
2. Practices in garlands, veni and floats making with with fresh flowers.
3. Techniques and styles in cut flower arrangements.
4. Practices in preparation of bouquets in different styles.
5. Practices in preparation of button-holes and flower baskets.
6. Practices in preparation of corsages and floral wreaths.
7. Identification of plants for dry flower making.
8. Practices in dry flower making.
9. Practices preparation of dry flower baskets.
10. Practices in preparation of bouquets, pot-pourri and button holes.
11. Practices in preparation of wall hangings, wreaths,etc.
12. Practices in preparation of greeting cards, etc.
13. Skeletanizing, leaf cup making and leaf painting.
14. Packaging and storage of fresh and dry flower products.
15. Visit to dry flower units.
16. Extraction methods of concrete, essential oil and pigments.
17. Visit to concrete, essential oil and pigment extraction units.

Course Outcome

CO1- The students must be able to demonstrate important value addition processes in flower crops.

CO2 - Students will gain skill in production of floral crafts and dry flower making.

CO3- Will gain skill and proficiency in floral arrangements.

CO - PSO - PO Mapping

	PSO1	PSO2	PSO3	PSO4	PO1	PO2	PO3	PO4	PO5	PO6
CO1	X		X	X	X	X		X		X
CO2	X		X	X	X	X		X		X
CO3	X		X	X	X	X		X		X

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FLA 624 TURFING AND TURF MANAGEMENT (2+1)

Learning Objectives

- **Students will know the nuances of turf management.**
- **The student will gain knowledge on scope, importance and features of different turf grasses and their features.**
- **The students will learn about turf establishment methods and maintenance procedure for different conditions.**

Theory

Unit I Importance of turf grass in industry

History of landscape gardening pertaining to turfing- importance and scope of turf industry in india- site selection- basic requirements- site evaluation- concepts of physical- chemical and biological properties of soil pertaining to turf grass establishment.

UNIT II Turf grasses

Turf grass- types- species- varieties- hybrids-propagation of turf grass- selection of grasses for different locations- grouping according to climatic requirement and adaptation.

UNIT III Preparatory operations

Growing media used for turf grasses - turf establishment methods- seeding-sprigging/dibbling- plugging- sodding/turfing- turf plastering- hydro-seeding- astro - turfing.

UNIT IV Turf management Irrigation- drainage- nutrition- special practices- aerating-rolling- soil top dressing- use of turf growth regulators (tgrs) and micronutrients- turf mowing – mowing equipments- techniques to minimize wear and compaction- weed control- biotic and abiotic stress management in turfs.

UNITV Turf establishment, Care and maintenance

Establishment and maintenance of turfs for playgrounds- viz. golf- football- hockey-cricket- tennis- rugby- etc- turfing for roof gardens- turfing for special purposes- repair and rejuvenation of old turf- equipments for turfing.

Current Stream of Thought

Practical

Identification of turf grasses- propagation of turf grasses- preparatory operations in turf making- practices in turf establishment- layout of macro and micro irrigation systems-water and nutrient management; drainage practices- special practices – mowing-raking- rolling- soil top dressing- use of turf growth regulators- weed management; biotic and abiotic stress management; project preparation for turf establishment- visit to it parks- model cricket and golf grounds- airports- corporates- govt. organizations; renovation of lawns; turf economics.

Lecture Schedule:

1. **History of landscape gardening pertaining to turfing.**
2. **Importance and scope of turf industry in India.**
3. **Site selection and site evaluation.**
4. **Basic requirements for turfing.**
5. **Concepts of physical, chemical and biological properties of soil pertaining to turf grass establishment.**
6. **Turf grass- Types, species.**
7. **Turf grass- varieties, hybrids.**
8. **Propagation of turf grass.**
9. **Selection of grasses for different locations.**
10. **Grouping of turf grasses according to climatic requirement and adaptation.**
11. **Growing media used for turf grasses.**
12. **Turf establishment methods- seeding, sprigging/dibbling and plugging.**
13. **Turf establishment methods-sodding/turfing, turf plastering and hydro-seeding.**
14. **Irrigation methods for different turfs.**
15. **Automized irrigation methods**

16. **Drainage methods for different turfs.**
17. **Mid semester examination.**
18. **Soil top dressing and micronutrients**
19. **Special practices- aerating and rolling.**
20. **Use of turf growth regulators (TGR's).**
21. **Turf mowing – mowing equipments,**
22. **Turf grass-Patterning**
23. **Techniques to minimize wear and compaction of turf.**
24. **Weed control in turfs.**
25. **Bioticstress management in turfs**
26. **Abiotic stress management in turfs.**
27. **Establishment and maintenance of turfs for golf ground.**
28. **Establishment and maintenance of turfs for football and hockey grounds.**
29. **Establishment and maintenance of turfs for cricket ground.**
30. **Establishment and maintenance of turfs for tennis, rugby grounds, etc.**
31. **Turfing for roof gardens.**
32. **Turfing for special purposes.**
33. **Repair and rejuvenation of old turf.**
34. **Equipments for turfing.**

Practical Schedule:

1. **Identification of turf grasses.**
2. **Propagation of turf grasses.**
3. **Preparatory operations in turf making.**
4. **Practices in turf establishment.**
5. **Layout of macro and micro irrigation systems.**
6. **Layout of drainage systems.**
7. **Water management practices.**
8. **Nutrient management practices.**
9. **Special practices – mowing, raking and rolling.**
10. **Soil top dressing and use of plant growth regulators.**
11. **Weed management practices.**
12. **Pest,diseases and nematode management practices.**
13. **Abiotic stress management practices.**
14. **Astroturfing practices.**
15. **Project preparation for turf establishment in cricket or football or hockey or golf ground.**
16. **Renovation of lawns.**
17. **Turf economics.**
18. **Visit to IT parks, model cricket and golf grounds, airports, corporates, Govt. organizations.**

Course Outcome

CO1- The students will be able to prepare a turf establishment project and to execute the same.

CO2 - The students will able to manage turf in commercial units.

CO - PSO - PO Mapping

	PSO1	PSO2	PSO3	PSO4	PO1	PO2	PO3	PO4	PO5	PO6
CO1	X	X		X	X	X	X			X
CO2	X	X		X	X	X	X			X
CO3	X	X		X	X	X	X			X

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OPC- HOR 711 PROPAGATION AND NURSERY MANAGEMENT OF HORTICULTURAL CROPS (2+1)

Learning Objectives

- To make the students learn different methods of plant propagation.
- To impart knowledge on nursery management of various horticultural crops.
- To make them familiarize with the tools and implements essential for all horticultural operations.

Theory

Unit I Principles of plant propagation

Sexual and asexual methods of propagation - principles and factors influencing seed germination-dormancy- hormonal regulation of germination and seedling growth- seed quality- packing- storage- certification and testing.

Unit II Anatomical and physiological aspects of plant propagation

Techniques of cottage - layerage- graftage and budding- compatibility- dwarfing rootstocks of important fruit trees.

Unit III Plant growth regulators and plant tissue culture

Role of PGR'S in plant propagation- role of nucellar embryony- apomixes- tissue culture techniques- hardening techniques .

Unit IV Planning of a nursery unit and modern propagation structures

Raising of nursery plants- selection- certification maintenance of mother plants and bud wood and root stock nurseries- use of modern structures- mist chambers- low cost poly houses- tunnel houses.

Unit V Marketing methods of nursery plants and economics

Media/soil mixtures- containers- use of machinaries- lifting- packing- transport-marketing- economics of raising nursery and management in different fruit crops.

Current Stream of Thought

Practical

Media/soil mixture- containers and soil sterilisation- use of chemicals for seed treatment and sowing- preparation of nursery beds- polybags- seedpans- thumb rule for raising seedlings- stratification and scarification of seeds and use of tetrazolium salts for germination tests-identification of nucellar seedlings- practice of different asexual methods of propagation- viz.-cuttage- layering- budding- approach- veneer and softwood grafting-use of plant growth regulators in propagation of plants -use of mist chambers- modern propagation structures- low cost polyhouses- low tunnels and bottom heating techniques- selection- lifting- packing- transportation and marketing of nursery plants- economics of raising nurseries- visit to local commercial/private nurseries.

Lecture schedule

1. Scope and importance of plant propagation.
2. Study of sexual and asexual methods of propagation.
3. Advantages and disadvantages of seed and vegetative propagation.
4. Factors influencing seed germination of Horticultural crops.
5. Studies on dormancy, hormonal regulation of germination and seedling growth.
6. Study of seed quality, packing, storage, certification and testing.
7. Study of anatomical and physiological aspects of asexual propagation.
8. Studies on graft compatibility on fruit crops.
9. Dwarfing rootstocks of commercial importance in fruit crops.
10. Role of PGR's in raising seedlings and rooting of cuttings and layers.

11. **Role of nucellar embryony and apomixis.**
12. **Studies on tissue culture techniques.**
13. **Micro grafting (STG).**
14. **Techniques of cuttings and layering.**
15. **Techniques of budding and grafting.**
16. **Planning of nursery unit.**
17. **Mid-semester examination**
18. **Study of raising of nursery plants and their after care- role of protray nursery and their after care.**
19. **Study of modern propagation structures.**
20. **Role of mist chambers in plant propagation.**
21. **Study of bottom heating techniques.**
22. **Hardening techniques in nursery.**
23. **Progeny orchard and scion bank.**
24. **Establishment of bud wood bank.**
25. **Media -soil mixture preparation for nursery plants.**
26. **Study of containers used for nursery.**
27. **Use of machineries in nurseries.**
28. **Soil sterilization techniques.**
29. **Irrigation systems in nursery plants.**
30. **Lifting and packing of nursery plants.**
31. **Transportation and marketing of nursery plants.**
32. **Nursery planning and layout .**
33. **Economics of raising nursery and management of different fruit crops.**
34. **Nursery acts.**

Practical schedule

1. **Media/soil mixture, containers and soil sterilization.**
2. **Use of chemicals for seed treatment and sowing.**
3. **Preparation of nursery beds, polybags, seedpans, thumbrule for raising seedlings.**
4. **Stratification and scarification of seeds and use of tetrazolium salts for germination.**
5. **Identification of nucellar seedlings.**
6. **Practice of different asexual methods of propagation, viz.,cuttage, layering.**
7. **Buddingmethods.**
8. **Grafting- methods.**
9. **Use of plant growth regulators in propagation.**
10. **Role of mist chambers in plant propagation.**
11. **Other protected structures uses for plant propagation.**
12. **Low cost polyhouses, low tunnels.**
13. **Bottom heating techniques and soil sterilization.**
14. **Selection, lifting, packing of nursery plants.**
15. **Transportation and marketing of nursery plants.**
16. **Economics of raising nurseries.**
17. **Visit to local commercial/private nurseries.**

Course Outcome

CO1- gain knowledge on physiology, principles, factors influencing, media and methods of propagation of Horticultural crops

CO2-gain skill in all propagation methods and technology for commercial scale adoption

CO3- become capable of managing commercial nursery business.

CO - PSO - PO Mapping

	PSO1	PSO2	PSO3	PSO4	PO1	PO2	PO3	PO4	PO5	PO6
CO1	X		X	X	X	X	X	X	X	X
CO2	X		X	X	X	X	X	X	X	X
CO3	X		X	X	X	X	X	X	X	X

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OPC-FLA 712# ORNAMENTAL HORTICULTURE (2+1)

Learning Objectives

- **Students will know about scope, importance and history of landscape and ornamental horticulture.**
- **The student will gain understanding of gardening principles, concepts, styles and components.**
- **Students will learn the landscape designing process and execution of garden design for different conditions.**

Theory

UNIT I Ornamental horticulture- History and principles

Ornamental horticulture-definition- scope and importance- history of ornamental horticulture. types of gardens. styles of garden- formal- informal and free style gardens. beauty components- basic principles of gardening.

UNIT II Softscape and Hardscape elements

Garden plant components-basic function and utility- arboretum- shrubbery- fernery- palmatum- edges and hedges -topiary and trophy- climbers and creepers- cacti and succulents- herbs- annuals- flower borders and beds- ground covers- carpet beds- bamboo groves; lawns- establishment and maintenance- production technology for selected ornamental plants .non-plant components.

UNIT III Special types of gardens and horticultural crafts

Special types of gardens- vertical garden- roof garden- bog garden- sunken garden- rock garden- clock garden- temple garden and sacred groves. Study on horticultural crafts- bonsai- terrarium and flower arrangement-

UNIT IV Landscape drawing

Site analysis- cliental preference- home- institute- industrial garden- public parks- amusements and theme parks- landscape drawing- fundamentals of manual drawing- scale- symbols- layout- plan view- elevation and perspective diagrams- computer software- manual and computer aided deigning- applications of CAD in landscape garden designing.

UNIT V Landscaping for specific situations

Urban landscaping- landscaping for specific situations- hospitals- roadsides- traffic islands- damsites- it parks- corporates. bio-aesthetic planning- eco-tourism- indoor gardening- therapeutic gardening- water scaping and xeriscaping.

Current Stream of Thought

Practical

Identification of ornamental plants and garden components- study of form- size- shape- texture- flowering season and description of trees- shrubs- flower bed- foliage bed- climbers and creeper- hedges- edges cacti- succulents- ferns and palms- evaluation of different styles of garden- turf- study of types of turf grasses- establishment- care and maintenance of turf- art of topiary- practices in planning and planting of special types of gardens- identification- planning and designing of non-living components- principles

and concepts in garden designing- techniques in transplanting of container grow plants- burlapping- tree transplanting- preparation of landscape plan layout- application of cad in landscape garden designing- project preparation on landscape execution for home- institute- industrial- public parks and theme parks. study on horticultural crafts- bonsai- terrarium and flower arrangement- visit to parks and botanical garden.

Lecture Schedule

1. **Ornamental horticulture-Definition, scope and importance.**
2. **History of ornamental horticulture,**
3. **Types of gardens.**
4. **Styles of garden, formal, informal and free style gardens**
5. **Beauty components**
6. **Basic principles of gardening.**
7. **Garden plant components, arboretum,**
8. **Shrubbery, fernery, palmatum, edges and hedges,**
9. **Climbers and creepers, cacti and succulents and herbs,**
10. **Annuals, flower borders and beds,**
11. **Ground covers, carpet beds and bamboo groves,**
12. **Lawns, Establishment and maintenance,**
13. **Production technology for selected ornamental plants.**
14. **Non-plant components-basic function and utility.**
15. **Special types of gardens, vertical garden and roof garden,**
16. **Bog garden, sunken garden and rock garden,**
17. **Mid semester examination.**
18. **Clock garden, temple garden, sacred groves.**
19. **Study on horticultural crafts, bonsai and terrarium.**
20. **Flower arrangement,**
21. **Site analysis, cliental preference,**
22. **Home, institute and industrial garden,**
23. **Public parks, amusements and theme parks,**
24. **Landscape drawing, fundamentals of manual drawing, scale, symbols and layout,**
25. **Plan view, elevation and perspective diagrams,**
26. **Computer software,manual and computer aided designing, applications of CAD in landscape garden designing.**
27. **Urban landscaping,**
28. **Landscaping for specific situations,residents, hospitals, roadsides and traffic islands,**
29. **Damsites, IT parks and corporates.**
30. **Bio-aesthetic planning,**
31. **Eco-tourism and theme parks**
32. **Indoor gardening,**
33. **Therapeutic gardening,**
34. **Water scaping and xeriscaping.**

Practical schedule

1. **Identification of ornamental plants and garden components.**

2-5 Study of form, size, shape, texture, flowering season and description of trees, shrubs, flower bed, foliage bed, climbers and creeper, hedges, edges cacti, succulents, ferns and palms.

6. **Evaluation of different styles of garden.**

7. Turf - study of types of turf grasses - establishment, care and maintenance of turf.

8. **Art of topiary –**
9. **Practices in planning and planting of special types of gardens.**

10-11. Identification, planning and designing of non-living components.

12. Techniques in transplanting of container grown plants, burlapping, tree transplanting.

13. Principles and concepts in garden designing.

14. Manual preparation of landscape plan layout.
15. Application of CAD in landscape garden designing.
16. Project preparation on landscape execution for home, institute, industrial, public parks and theme parks.
17.Study on horticultural crafts, bonsai, terrarium and flower arrangement. Visit to parks and botanical garden

Course Outcome

CO1- The students will be able to identify different soft and hard landscape elements.
CO2 - The students will be capable of designing and managing a garden project.
CO3-

CO - PSO - PO Mapping

	PSO1	PSO2	PSO3	PSO4	PO1	PO2	PO3	PO4	PO5	PO6
CO1	X	X		X	X	X	X			X
CO2	X	X		X	X	X	X			X
CO3	X	X		X	X	X	X			X

References

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2. **Bose, T.K., R.G. Maiti, R.S. Dhua. and P. Das. 1999. Floriculture and Landscaping. NayaProkash, Kolkatta.**
3. **Brain Closton.1984. Landscape design with plants. Van Nostrad Reinhod company NewYork.**
4. **Gopalasamy Iyyankar.1970.Complete Gardening In India. Kalyan Printers, Bangalore.**
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DEPARTMENT OF HORTICULTURE

GHOR 24 M.Sc. (HORTICULTURE) IN PLANTATION, SPICES MEDICINAL & AROMATIC CROPS

Programme Outcome

Any post graduate from the Faculty of Agriculture will

PO1. have core knowledge leading to awareness on advancements in the field of agriculture and horticulture including crop production, soil fertility, crop protection, crop improvement, microbiology, bio technology, agricultural extension and economics.

PO2. have basic understanding and skill on experimental tools in biological sciences, analytical techniques for plant and soil samples, microbial technologies, biotechnological tools, breeding methods, statistical tools & analysis, research data computation, etc, required for higher learning, research and development.

PO3. be mastering the modern agronomic techniques of crop production, water, soil & nutrient management, plant protection with respect to insect pest and plant diseases , crop improvement and ecosystem restoration.

PO4. will be able to design and execute individual research project, write concise & persuasive research articles and communicate effectively with their scientific colleagues, farmers and the general public.

PO5. be able to communicate research and educational materials properly and competently and

PO6. be able to address complex problems taking into account related ethical, social, legal, economic, and environmental issues.

Programme Specific Outcome

The student will be able to

PSO1- acquire knowledge on crop improvement, production technologies, and post harvest technologies pertaining to Plantation, Spices Medicinal & Aromatic Crops.

PSO2- recommend suitable package of practices to various stake holders.

PSO3- carryout individual research works in plantation, spices medicinal & aromatic crops and writing reports.

PSO4- become eligible to work in commercial horticultural units, research projects, processing industries, etc.

GHOR 24 M.Sc. (HORTICULTURE) IN PLANTATION, SPICES, MEDICINAL AND AROMATIC CROPS

DISTRIBUTION OF COURSES

S. No.	Course Code	Course Title	Credit Hours
		Major courses	
1.	PSM 611	Breeding of plantation and spice crops	2+1
2.	PSM 612	Breeding of medicinal and aromatic crops	2+1
3.	PSM 613	Production technology of plantation crops	2+1
4.	HOR 621 PSM 621	Growth regulation and stress management in horticultural crops (or) Production technology of medicinal and aromatic crops	2+1
5.	PSM 622	Production technology of spice crops	2+1
6.	PSM 623 PSM 624	Organic Cultivation of spices and plantation crops production (or) Underexploited medicinal and aromatic plants	1+1
7.	PSM 625	Processing of plantation, spice, medicinal and aromatic crops	2+1
			13+7=20
8.	PSM 011/021/031/041	Research(0+1)+(0+2)+(0+8)+(0+9)	0+20
9.	PSM 032	Seminar	0+1
		Minor courses	
1.	OPC-CRP 621	Concepts of crop physiology	2+1
2.	OPC-XXX	Minor course from other departments /related disciplines	2+1
3.	OPC-XXX	Minor course from other departments /related disciplines	2+1
			6+3=9
		Supporting courses	
1.	STA 611	Statistical methods and design of experiments	2+1
2.	COM 611	Computer applications for agricultural research	1+1
		Non - credit compulsory courses	
1.	PGS 611	Agricultural research ethics and methodology	0+1
2.	PGS 612	Technical writing and communication skills	0+1
3.	PGS 623	Basic concepts in laboratory techniques	0+1
4.	PGS 624	Library and information services	0+1
5.	PGS 715*	Intellectual property rights and its management in agriculture	1+0
6.	PGS 716*	Disaster management	1+0
			2+4=6

*e-course

GHOR 24 M.Sc. (HORTICULTURE) IN PLANTATION, SPICES, MEDICINAL AND AROMATIC CROPS
SEMESTER WISE DISTRIBUTION OF COURSES

SEMESTER I			
S. No.	**Course Code**	**Course Title**	**Credit Hours**
1.	PSM 611	Breeding of plantation and spice crops	2+1
2.	PSM 612	Breeding of medicinal and aromatic crops	2+1
3.	PSM 613	Production technology of plantation crops	2+1
4.	STA 611	Statistical methods and design of experiments	2+1
5.	COM 611	Computer applications for agricultural research	1+1
6.	PSM 011	Research(0+1)+(0+2)+(0+8)+(0+9)	0+1
7.	PGS 611	Agricultural research ethics and methodology *	0+1
8.	PGS 612	Technical writing and communication skills *	0+1

		SEMESTER-II	
S. No.	**Course Code**	**Course Title**	**Credit Hours**
1.	HOR 621 PSM 621	Growth regulation and stress management in horticultural crops (or) Production technology of medicinal and aromatic crops	2+1
2.	PSM 622	Production technology of spice crops	2+1
3.	PSM 623 PSM 624	Organic Cultivation of spices and plantation crops production (or) Underexploited medicinal and aromatic plants	1+1
4.	PSM 625	Processing of plantation, spice, medicinal and aromatic crops	2+1
5.	PSM 021	Research	0+2
6.	OPC-GPB 621	Concepts of crop physiology	2+1
7.	PGS 623	Basic concepts in laboratory techniques*	0+1
8.	PGS 624	Library and information services *	0+1

		Semester-III	
S. No.	**Course Code**	**Course Title**	**Credit Hours**
1.	**OPC-XXX**	**Minor course from other departments /related disciplines**	**2+1**
2.	**OPC-XXX**	**Minor course from other departments /related disciplines**	**2+1**
	OPC-HOR 711#	**Propagation and nursery management of horticultural crops**	**2+1**
	OPC-PSM 712#	**Genetic resources and conservation of medicinal and aromatic crops**	**2+1**
3.	**PSM 031**	**Research**	**0+8**
4.	**PSM 032**	**Seminar**	**0+1**
5.	**PGS 715**	**Intellectual property rights and its management in agriculture ***	**1+0**
6.	**PGS 716**	**Disaster management ***	**1+0**
7.	**PGS 717**	**Constitution of India ***	**1+0**
		Semester-IV	
S. No.	**Course Code**	**Course Title**	**Credit Hours**
1.	**PSM 041**	**Research**	**0+9**
2.	**VASC**	**Value added course***	**3+0**

#-Optional course offered to other departments/discipline only

***Non – credit Compulsory course**

ABSTRACT

Course	**Semester wise credit distribution**				**Total**
	I	**II**	**III**	**IV**	
Major	**9**	**11**	**-**	**-**	**20**
Minor	**-**	**3**	**6**	**-**	**9**
Supporting	**5**	**-**	**-**	**-**	**5**
Seminar	**-**	**-**	**1**	**-**	**1**
Research	**1**	**2**	**8**	**9**	**20**
Total credits	**15**	**16**	**15**	**9**	**55**
Non-credit	**Two courses**	**Two courses**	**Three courses**	**One Course**	**Eight courses**

PSM 611 BREEDING OF PLANTATION AND SPICE CROPS (2+1)

Learning Objectives

- **To gain comprehensive knowledge about the breeding methodologies, concepts and principles of breeding the plantation of spice crop**
- **To gain knowledge in crop improvement of the plantation and spice crops**

Theory

Species and cultivars- cytogenetics- survey- collection- conservation and evaluation- blossom biology- breeding objectives- approaches for crop improvement- introduction- selection- hybridization- mutation breeding- polyploid breeding- improvement of quality traits- resistance breeding for biotic and abiotic stresses- molecular aided breeding and biotechnological approaches- marker-assisted selection- bioinformatics- ipr issues- achievements and future thrusts.

UNIT I Breeding of plantation crops –I

Coffee, cashew, cocoa & rubber

UNIT II Breeding of plantation crops –II

Palmyrah oil palm, coconut & arecanut

UNIT III Breeding of spices crops -I

Black pepper,cardamom, ginger

UNIT IV Breeding of spice crops- II

Fenugreek, coriander, fennel

UNIT V Breeding of spice crops - III

Nutmeg, cinnamon, clove, allspice

Current Stream of Thought

Practical

Characterization and evaluation of germplasm accessions- blossom biology- studies on pollen behaviour- practices in hybridization- ploidy breeding- mutation breeding- evaluation of biometrical traits and quality traits- screening for biotic and abiotic stresses- haploid culture- protoplast culture and fusion- induction of somaclonal variation and screening the variants. Identification and familiarization of spices; floral biology anthesis; fruit set; selfing and crossing techniques; description of varieties. Salient features of improved varieties and cultivars from public and private sector- bioinformatics- visit to radiotracer laboratory- national institutes for plantation crops and plant genetic resource centers- genetic transformation in plantation crops for resistance to biotic stress/quality improvement etc.

Lecturer schedule

1. **Species and cultivars- cytogenetics- survey- collection- conservation and evaluation- blossom biology- breeding objectives- approaches for crop improvement- introduction selection- hybridization - mutation breeding- polyploidy breeding- improvement of quality traits- resistance breeding for biotic and abiotic stresses- molecular aided breeding and biotechnological approaches marker assisted selection- bio in formatics- ipr issues. achievements and future thrusts of following crops.**
2. **Methods of breeding in perennial spices**
3. **Methods of breeding in seed spices**
4. **Methods of breeding in plantation crops**
5. **Biotechnological approaches in breeding of spice crops**
6. **IPR issues, protection of plant varieties and farmers rights act.**
7. **Breeding methods in Tea**
8. **Coffee**
9. **Cashew**
10. **Cocoa**
11. **Cocounts**
12. **Rubber**
13. **Arecanut**
14. **Palmyrah**
15. **Betelvine**

16. Oil palm
17. Mid- semester examination
18. Black pepper
19. Cardamom
20. Ginger
21. Turmeric
22. Fenugreek
23. Coriander
24. Fennel
25. Cumin
26. Cinnamon
27. Clove
28. All spice
29. Ajowan
30. Dill, Celery
31. Tamarind,
32. Garcinia
33. Saffron,
34. Vanilla

Practical schedule

1. Scoring techniques for genomic status in coffee and tea.
2. Study of blossom biology in Coffee and tea.
3. Study of blossom biology in Cashew and Cocoa
4. Study of blossom biology in Coconut and arecanut
5. Study of blossom biology in Rubber, palmyrah and Oil palm.
6. Study of floral biology, anthesis in Black pepper, cardamom, ginger and turmeric.
7. Study of floral biology, anthesis in fenugreek, coriander, fennel and nutmeg.
8. Study of floral biology, anthesis in cinnamon, clove and celery.
9. Practices in in-vitro approaches in improvement of plantation crops.
10. Practices in in-vitro approaches in improvement of spice crops.
11. Estimation of pollen output, viability and germinability in plantation crops.
12. Estimation of pollen output, viability and germinability in spice crops
13. Practices in hybridization of fenugreek, coriander.
14. Screening techniques for resistance against abiotic stress -salt and drought tolerance in possible plantation crops.
15. Screening techniques for resistance against abiotic stress -salt and drought tolerance in possible spice crops.
16. Visit to research institutes working on important plantation crops and studying breeding programmes.
17. Visit to research institutes working on important spice crops and studying breeding programmes.

Course Outcome

CO1- The students must be able to demonstrate different breeding techniques in plantation and spice crops

CO2- The student will develop the capacity to become a breeder in plantation and spice crops.

CO - PSO - PO Mapping

	PSO1	PSO2	PSO3	PSO4	PO1	PO2	PO3	PO4	PO5	PO6
CO1	X		X		X	X		X	X	X
CO2	X			X	X	X		X	X	X

References

1. Arya, P.S. 2003. Spice crops of India. Kalyani Publishers, New Delhi.
2. Chadha, K.L., P.N. Ravindran. and L. Sahijram. 2000.Biotechnology in Horticulture and Plantation Crops. Malhotra Publ.,India.

3. Nybe, E.V., N. Miniraj. and K.V. Peter. 2007. Spices New India. Publishers Agency, New Delhi.
4. Peter, K.V. 2001. Hand book of herbs and spices Vol I-II Wood Head Publishers Co, USA
5. Peter, K.V. and Z. Abraham (Eds). 2007. Biodiversity in horticultural crops. Vol.1 Daya publishers, New Delhi.
6. Peter, K.V. (Ed). 2010. Biodiversity in Horticultural crops . Vol.3 Daya publishers, New Delhi.
7. Ramawat, K.G. and J.M. Merillon. 2003. Biotechnology secondary metabolites. Oxford and IBH., new Delhi.
8. Shanmugavelu, K.G., N. Kumar. and K.V. Peter. 2002. Production technology of spices and plantation crops. Agrobios, Jodhpur

PSM 612 BREEDING OF MEDICINAL AND AROMATIC CROPS (2+1)

Learning Objectives

- To gain comprehensive knowledge about the breeding methodologies, concepts and principles of medicinal and aromatic crops instead plantation and spices
- To gain knowledge in crop improvement of the plantation and spice crops

Theory

UNIT I Scope and importance

Plant bio-diversity- conservation of germplasm- ipr issues- major objectives of breeding of medicinal and aromatic crops- scope for introduction- cytogenetic background of important medicinal and aromatic crops- scope for improvement of medicinal and aromatic crops -through selection- intra and interspecific hybridization- induced autotetraploidy- mutation breeding and biotechnological approaches.

UNIT II Breeding techniques

Breeding for yield and quality improvement in medicinal plants- breeding for high herbage yield- essential oil and quality components- secondary metabolites in medicinal and aromatic crops; genetics of active principles and assay techniques useful in evaluation of breeder's material.breeding problems in seed and vegetatively propagated medicinal and aromatic crops.

UNIT III Achievements and prospects in breeding of medicinal crops

Achievements and prospects in breeding of medicinal crops- viz. senna madagascar-periwinkle- glory lily- coleus forskohlii- stevia- ashwagandha- poppy-isabgol- dioscorea.

UNIT IV Breeding of medicinal crops

Prospects in breeding of medicinal crops- viz. chlorophytum sp- rauvolfia serpentina-aloe vera- ocimum sp- phyllanthus amarus- solanum sp.

UNIT V Breeding of aromatic crops

Prospects in breeding of aromatic crops viz.- geranium- vettiver- lemon grass-palmarosa- citronella- rosemary- patchouli- eucalyptus- artemisia and mint.

Current Stream of Thought

Practical

Characterization and evaluation of germplasm accession- blossom biology- studies on pollen behaviour- practices in hybridization- ploidy breeding- mutation breeding-evaluation of biometrical traits and quality traits- screening for biotic and abiotic stresses of medicinal and aromatic crops- identification and familiarization of spices; selfing and crossing techniques and description of varieties- high alkaloid- and high essential oil mutants- evolution of mutants through physical and chemical mutagens in medicinal and aromatic crops.

Lecture schedule

1. Methods of breeding for medicinal plants
2. Methods of breeding for aromatic plants
3. Biotechnological approaches in breeding of medicinal plants and aromatic plants
4. Biodiversity and germplasm conservation
5. IPR issues and PPFR

6. **Ashwagandha**
7. **Aloe vera**
8. **Senna**
9. **Sarpagandha**
10. **Glory lily**
11. **Coleus**
12. **Dioscorea**
13. **Ocimum**
14. **Periwinkle**
15. **Solanum**
16. **Gymnema**
17. **Mid-semester examination**
18. **Geranium**
19. **Medicinal yam**
20. **Poppy**
21. **Stevia**
22. **Kalmegh**
23. **Isabgol**
24. **Phyllanthus, safed musli**
25. **Palmarosa**
26. **Lemongrass**
27. **Citronella**
28. **Mentha**
29. **Ocimum**
30. **Rosemary**
31. **Thyme**
32. **Patchouli, Eucalyptus**
33. **Lavender, Marjoram**
34. **Oreganum, Artemisia.**

Practical schedule

1. **Study of floral biology, anthesis and pollination mechanisms in medicinal crops.**
2. **Study of floral biology, anthesis and pollination mechanisms in aromatic crops.**
3. **Characterization, evaluvation and screening of germplasm accessions in medicinal crops.**
4. **Characterization, evaluvation and screening of germplasm accessions in aromatic crops.**
5. **Hybridization techniques in medicinal crops.**
6. **Hybridization techniques in aromatic crops.**
7. **Introduction to mutation breeding in medicinal crops.**
8. **Introduction to mutation breeding in aromatic crops.**
9. **Introduction to polyploidy breeding in medicinal crops.**
10. **Introduction to polyploidy breeding in aromatic crops.**
11. **Practices in in-vitro approaches in improvement of medicinal crops.**
12. **Practices in in-vitro approaches in improvement of aromatic crops.**
13. **Identification and description of high alkaloid and essential oils.**
14. **Visit to radiation laboratory.**

15-16 Visit to commercial oil extraction units.

17.Visit to National institutes.

Course Outcome

CO1- Students will be able to understand the different breeding methods followed in medicinal and aromatic crops.

CO2- They will be able to demonstrate and carry out different techniques employed in breeding of medicinal and aromatic.

CO - PSO - PO Mapping

	PSO1	PSO2	PSO3	PSO4	PO1	PO2	PO3	PO4	PO5	PO6
CO1	X		X		X	X		X	X	X
CO2	X			X	X	X		X	X	X

References

1. **Farooqi, A.A., M.M. Khan and M. Vasundhara. 2001 Production technology of medicinal and aromatic crops. Natural remedies Pvt.ltd**
2. **Jain, S.K. 2000. Medicinal plants. National Book Trust, India.**
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5. **Hota, D. 2007. Bio active medicinal plants, ePub: http://isbninspire.com/pdf123/offer.php?id=8189729195.**
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8. **Ramawat, K.G. and Merillon. 2011. Biotechnology secondary metabolites Oxford and IBH, New Delhi.**

PSM 613 PRODUCTION TECHNOLOGY OF PLANTATION CROPS (2+1)

Learning Objectives

- **Students will able to learn about advances in production technologies of plantation crops**
- **Students will gain basic knowledge in production technologies of plantation crops**

Theory

Role of plantation crops in national economy- export potential- ipr issues- clean development mechanism- classification and varietal wealth- plant multiplication including *in vitro* **multiplication- systems of cultivation- multitier cropping- photosynthetic efficiencies of crops at different tiers- rainfall- humidity- temperature- light and soil ph on crop growth and productivity- high density planting- nutritional requirements- physiological disorders- role of growth regulators and macro and micro nutrients- water requirements- fertigation- moisture conservation- shade regulation- weed management- training and pruning- crop regulation- organic production technologies- maturity indices- harvesting- post harvest practices- cost benefit analysis- organic farming- management of drought- precision farming of the following crops.**

Unit I Production technology of plantation crops -I
Tea and coffee

Unit II Production technology of plantation crops -II
Rubber and cashew

Unit III Production technology of plantation crops- III
Coconut and arecanut

Unit IV Production technology of plantation crops- IV
Palmyrah- oil palm and cocoa

Unit V Production technology of plantation crops -V
Wattle and betel vine

Current Stream of Thought

Practical

Description of botanical and varietal features of plantation crops- selection of mother palms and seedlings in coconut and arecanut- processing and value addition of plantation crops- visit to plantation industries and commodity boards.

Lecture schedule

1. Role of plantation crops in national economy, export potential and imports, area and production.

2. IPR issues in plantation crops.

Varietal status, eco physiological requirements, recent trends in plant multiplication, planting and high density planting, cropping systems, irrigation and fertigation, role of major and minor nutrients,nutrient management, growth regulators and shade regulation training and pruning, weed management, soil and moisture conservation, major biotic stresses and their management, harvesting, curing, processing, grading, packing, storage and value addition of the following crops:

3-6. Tea

7- 10. Coffee

11-13.Rubber

14-16.Cashew

17. Mid semester examination

18-21.Coconut

22-24.Arecanut

25-26.Palmyrah

27-28.Oil palm

29-30.Cocoa

31. Wattle

32. Betel vine

33. Organic farming in plantation crops.

34. Role of commodity boards and developmental institutions in plantation crops.

Practical schedule

1. **Description of botanical and varietal features of tea.**
2. **Description of botanical and varietal features of coffee.**
3. **Processing of tea and coffee.**
4. **Description of botanical and varietal features of rubber.**
5. **Description of botanical and varietal features of cashew.**
6. **Processing of rubber and cashew.**
7. **Description of botanical and varietal features of coconut.**
8. **Selection of mother palms and seed nuts, quality nursery production in coconut.**
9. **Description of botanical and varietal features of arecanut.**
10. **Processing of arecanut.**
11. **Description of botanical and varietal features of palmyrah.**
12. **Description of botanical and varietal features of cocoa.**
13. **Processing of cocoa.**
14. **Description of botanical and varietal features of betel vine.**
15. **Description of botanical and varietal features of oil palm and wattle.**

16-17. Visit to Commodity Boards and plantation industries.

Course Outcome

CO1: Students will be able to appreciate the research advancements made in plantation crops.

CO2: They will be able to recommend suitable package of practices for enhanced production of plantation crops.

CO3: Students will be able to manage plantation estates

CO - PSO - PO Mapping

	PSO1	PSO2	PSO3	PSO4	PO1	PO2	PO3	PO4	PO5	PO6
CO1	X	X	X	X	X	X	X	X	X	X
CO2	X	X	X	X	X	X	X	X	X	X
CO3	X	X		X	X	X	X	X	X	X

References

1. **Anonymous, 1985. Rubber and its Cultivation.The Rubber Board of India.**
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PSM 621 PRODUCTION TECHNOLOGY OF MEDICINAL AND AROMATIC CROPS (2+1)

Learning Objectives

- To gain comprehensive knowledge about the breeding methodologies, concepts and principles of Production technology of medicinal and aromatic crops
- To gain knowledge in crop improvement of the plantation and spice crops

Theory

Herbal industry- WTO scenario- export and import status- indian systems of medicine- indigenous traditional knowledge- ipr issues- classification of medicinal crops- systems of cultivation- organic production- role of institutions and ngo's in production- gap in medicinal crop production- production technology- organic practices- post harvest handling- drying- processing- grading- packing and storage- processing and value addition gmp and quality standards in herbal products- phytochemical extraction techniques- aromatic industry- wto scenario- export and import status- indian perfumery industry- production technology- post-harvest handling- distillation methods- advanced methods- solvent extraction process- quality analysis- value addition- institutional support and international promotion of essential oil and perfumery products.

Unit I Production technology of medicinal plants -I

Senna- coleus- ashwagandha- glory lily- sarpagandha

Unit II Production technology of medicinal plants -II

Dioscorea sp. *Aloe vera*- Phyllanthus- kalmegh- medicinal solanum- gymnema

Unit III Production technology of aromatic crops- I

Isabgol- ipecac- periwinkle- poppy- safed musli- stevia

Unit IV Production technology of aromatic crops -II

Palmarosa- lemon grass- citronella- vettiver- geranium- mentha- artemisia

Unit V Production technology of aromatic crops -III

Ocimum- eucalyptus- rosemary- thyme- patchouli- lavender- marjoram- origanum.

Current Stream of Thought

Practical

Botanical description- propagation techniques- maturity standards- extraction of secondary metabolites- project preparation for commercially important medicinal crops- visit to medicinal crop fields- visit to herbal extraction units- extraction of essential oils- project preparation for commercially important aromatic crops- visit to distillation and value addition units.

Lecture schedule

1. Herbal industry, WTO scenario, export and import status.
2. Indian system of medicine, indigenous traditional knowledge of medicinal plants.
3. Classification of medicinal plants and systems of cultivation.
   Climate and soil requirements, varieties-site selection, season and method of propagation, pre sowing treatment, irrigation and nutrient management, intercultural operations, plant protection measures, maturity indices-harvesting and post harvest management of the following crops:
4. Senna

5. **Coleus**
6. **Ashwagandha**
7. **Glory lily**
8. **Sarpagandha**
9. **Dioscorea and Aloe vera**
10. **Phyllanthus and kalmegh**
11. **Gymnema**
12. **Medicinal solanum and ipecac**
13. **Isabgol and safedmusli**
14. **Poppy**
15. **Periwinkle and stevia**
16. **Phytochemical extraction techniques**
17. **Mid -semester examination**
18. **Aromatic industry-WTO scenario- export and import status**
19. **Indian perfumery industry- history-advancements in perfume industry**
20. **Palmarosa and lemongrass**
21. **Citronella and vettiver**
22. **Geranium and artemisia**
23. **Mint**
24. **Ocimum**
25. **Patchouli**
26. **Rosemary and thyme**
27. **Origanum and marjoram**
28. **Lavender and eucalyptus**
29. **Organic production of medicinal and aromatic crops**
30. **IPR issues for medicinal and aromatic crops**
31. **Role of institutions and NGO's in production and regulations for herbal raw materials**
32. **Distillation methods, advanced methods-solvent extraction process, steam distillation**
33. **Perfumes from non-traditional plants.**
34. **Quality analysis, value addition, aroma chemicals, quality standards and regulation.**

Practical schedule

Botanical description of species - improved cultivars - propagation techniques - maturity standards - harvest and post harvest handling of the following crops:

1. **Senna and coleus**
2. **Aloe vera and ashwagandha**
3. **Gymnema, sarpagandha and poppy**
4. **Phyllanthus, kalmegh and ipecac**
5. **Medicinal solanum, safedmusli and dioscorea**
6. **Periwinkle, isabgol and stevia**
7. **Aromatic grasses**
8. **Geranium and mint**
9. **Ocimum and patchouli**
10. **Vettiver and eucalyptus**
11. **Rosemary, thyme, oreganum and marjoram**
12. **Extraction of secondary metabolites in medicinal crops**
13. **Extraction of essential oils from aromatic crops**
14. **Project preparation for commercially important medicinal and aromatic crops**
15. **Field visit to commercial medicinal plantations**
16. **Field visit to commercial aromatic plantations**
17. **Visit to herbal extraction units, distillation and value addition units**

Course Outcome

CO1: Students will be able to appreciate the research advancements made in medicinal and aromatic crops.

CO2: They will be able to recommend suitable package of practices for enhanced production of medicinal and aromatic crops.

CO - PSO - PO Mapping

	PSO1	PSO2	PSO3	PSO4	PO1	PO2	PO3	PO4	PO5	PO6
CO1	X	X	X	X	X	X	X	X	X	X
CO2	X	X	X	X	X	X	X	X	X	X

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PSM 622 PRODUCTION TECHNOLOGY OF SPICE CROPS (2+1)

Learning Objectives

- To gain comprehensive knowledge about diversification of spices, importance, export, employment potential and production technology of spices grown in India
- To gain knowledge in Good Agricultural practices in spice production.

Theory

Introduction- importance of spice crops-historical accent- present status - national and international- future prospects- botany and taxonomy- climatic and soil requirements- commercial varieties/hybrids- site selection- layout- sowing/planting time and methods- seed rate and seed treatment- nutritional and irrigation requirements- intercropping- mixed cropping- intercultural operations- weed control-mulching- physiological disorders- harvesting- post harvest management- plant protection measures and seed planting material and micro-propagation- precision farming- organic resource management- organic certification- quality control-pharmaceutical significance and protected cultivation of:

Unit I Production technology of major spices- I

Black pepper, cardamom

Unit II Production technology of major spices -II

Turmeric, ginger and garlic

Unit III Production technology of tree spices

Clove, cinnamon, nutmeg and allspice

Unit IV Production technology of seed spices

Coriander, fenugreek, cumin, fennel, ajowain, dill and celery

Unit V Production technology of minor spice crops

Tamarind, garcinia, vanilla and herbal spices

Current Stream of Thought

Practical

Identification of seeds and plants- botanical description of plants preparation of herbarium- propagation- nursery raising- field layout and method of planting- cultural practices- harvesting- drying- storage- packaging and processing- value addition; short term experiments on spice crops

Lecture schedule

1. History and classification of spices

2. Scope and importance, area, production, productivity, export potential of spices. Crop improvement, varieties, propagation and production technology of the following crops:

3. Black Pepper

4. Cardamom

5. Turmeric

6. Ginger

7. Garlic

8. Clove

9. Cinnamon

10. Nutmeg

11. All spice

12. Coriander

13. Fenugreek

14. Cumin

15-16 Fennel

17. Mid Semester Examination

18. Ajowain

19. Dill

20-22. Celery

23-25. Tamarind

26. Garcinia

27. Vanilla

28. Herbal spices

29. Organic spice production

30-31 Precision farming practices in spice.

32-33. Role of commodity boards in spice development.

34. Good Agricultural Practices for spice production

Practical schedule

1. **Description of related species and varieties of black pepper and cardamom**
2. **Propagation and rapid multiplication in pepper and cardamom**
3. **Processing of pepper and cardamom**
4. **Description of related species and varieties of turmeric and ginger**
5. **Processing of turmeric and ginger**
6. **Description of related species and varieties of garlic**
7. **Description of related species and varieties of tree spices**
8. **Nursery techniques in tree spices**
9. **Description of related species and varieties of seed spices**
10. **Nursery techniques in seed spices**
11. **Description of related species and varieties of tamarind, garcinia and vanilla**
12. **Description of related species and varieties of herbal spices**
13. **Protected cultivation of spices**
14. **Value addition in spices**
15. **Project preparation**
16. **Visit to spice gardens**
17. **Visit to commodity boards**

Course Outcome

CO1: Students will be able to appreciate the research advancements made in spice crops.

CO2: They will be able to recommend suitable package of practices for enhanced spice production.

CO - PSO - PO Mapping

	PSO1	PSO2	PSO3	PSO4	PO1	PO2	PO3	PO4	PO5	PO6
CO1	X	X	X	X	X	X	X	X	X	X
CO2	X	X	X	X	X	X	X	X	X	X

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PSM 623 ORGANIC CULTIVATION OF SPICES AND PLANTATION CROPS PRODUCTION (1+1)

Learning Objectives

- To gain comprehensive knowledge about principles, concepts and production of organic farming in spice and plantation crops.
- The student will gain knowledge in GAP, Organic certification and regulatory mechanism in organic production spices and plantation crops.

Theory

UNIT I Concepts in organic cultivation

Importance- principles- perspective- concept and component of organic production of spice and plantation crops.

UNIT II Organic production of spice and plantation crops

Organic production of spice crops and plantation crops- viz. pepper- cardamom- turmeric- ginger- cumin- vanilla- coconut- coffee- cocoa- tea- arecanut.

UNIT III Management strategies of organic fields -I

Managing soil fertility status - pests and diseases and weed problems in organic farming system; crop rotation in organic horticulture; processing and quality control for organic foods.

UNIT IV Management strategies of organic fields -II

Methods for enhancing soil fertility- mulching- raising green manure crops. Indigenous methods of compost- panchakavya- biodynamics- preparation etc.; pest and disease management in organic panchakavya farming; itk's in organic farming. Role of botanicals and bio-control agents.

UNIT V Handling of organic products

GAP and GMP- Certification of organic products; organic production and export - opportunity and challenges.

Current Stream of Thought

Practical

Method of preparation of compost, vermicomposting, biofertilizers, soil solarization, bio pesticides in horticulture, green manuring, mycorrhizae and organic crop production, waste management, organic soil amendment for root disease, weed management in organic horticulture- visit to organic fields and marketing centers.

Lecture schedule

Importance – Principles – Certification of organic production – Organic farming system – methods for enhancing soil fertility.

1. **Organic farming principles**
2. **Managinf of soil fertility**
3. **Pepper, Cardamom**
4. **Turmeric, Ginger**
5. **Cumin, Vanilla**
6. **Coconut, Coffee**
7. **Cocoa, Tea**
8. **Arecanut**
9. **Mid-semester examination**
10. **Processing and quality control for organic foods.**
11. **Methods of enhancing soil fertility**
12. **Different mulching and raising green manure crops**
13. **Panchagavya, Bio-dynamic preparations.**
14. **Pest and disease management in organic farming**
15. **Role of botanical and bio –control agent**
16. **GAP and GMP certification of organic products**
17. **Production and export details in organic products.**

Practical Schedule

1. **Soil physical parameters with relevance to organic horticulture.**
2. **Estimate on soil chemical parameters (pH, EC and ESP).**
3. **Nursery bed soil solarization for spices and plantation crops.**
4. **Agro techniques for composting farm wastes and agro industrial wastes.**
5. **Recycling of crop wastes through vermiculture.**
6. **Preparation of panchakavya humic acid and sea weed extract.**
7. **Preparation of activated EM solution, Munchurian mushroom tea and vermiwash .**
8. **Organic production of spices crops**
9. **Organic production of plantation crops**
10. **Application of various mulch materials to horticultural crops.**
11. **Study of bio agents for crop protection.**
12. **Preparation of organic formulations for pest control.**
13. **Preparation of organic formulations for disease control.**
14. **Organic certification, standards and agencies**
15. **Working out indices for organic horticulture.**
16. **Economic evaluation of organic horticulture system.**

Visit to farmers field under organic cultivation

Course Outcome

CO1:The students will be able to recommend suitable organic package of practices for enhanced spice production

CO2:They will be able to establish various organic input production units.

CO - PSO - PO Mapping

	PSO1	PSO2	PSO3	PSO4	PO1	PO2	PO3	PO4	PO5	PO6
CO1	X	X	X	X	X	X	X	X	X	X
CO2	X	X	X	X	X	X	X	X	X	X

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PSM 624 UNDER EXPLOITED MEDICINAL AND AROMATIC CROPS (1+1)

Learning Objectives

- **To facilitate understanding on the importance- conservation and cultivation of medicinal and aromatic crops.**
- **To gain knowledge in utilization and value addition in under utilized medicinal and aromatic crops.**

Theory

UNIT I Introduction and importance of less known medicinal and aromatic crops

Introduction- importance- present status and future prospects- origin- distribution- species- varieties- economic parts and their uses in different diseases- biodiversity and conservation- RET (Rare- Endangered and Threatened) and MPCAs (Medicinal Plants Conservation Areas).

UNIT II Utility status of less known medicinal and aromatic crops

Underutilized species – importance- traditional usage- ISM- TCM- Functional foods.

UNIT III Production technology of underutilized aromatic crops

Production technology of underutilized medicinal crops– noni sappamgu- kallimudayan- terminalia- chebula- bilawal poison nut- thoodhuvalai- physalis- bael- thai galangal- cadamba- costus.

UNIT IV Processing and value addition

Production technology of underutilized aromatic crops *Curcuma aromatica- Coleus aromaticus- Ocim- Kilimandscharicum- Bursera.*

UNIT V National and international conservation network

IPR issues- Promotion of under utilized species- Processing and value addition- marketing.

Current Stream of Thought

Practical

Collection of endangered plant species - establishment of endangered plant species - alkaloid estimation - essential oil extraction methods - visit to related industries - value added spice product- harvesting and packaging techniques for minimal loss in medicinal crops - harvesting and packaging techniques for minimal loss in aromatic crops - harvesting and packaging techniques for minimal loss in spices crops.

Lecture schedule

1. Types and methods of biodiversity and conservation of medicinal plants.

2. RET (Rare, Endangered and Threatened) and MPCAS (Medicinal plants conservation areas).

3. Under utilized species – importance, traditional usage, ISM, TCM, functional foods.

4-8. Production technology of medicinal crops

9. Mid semester examination

10 Morinda citrifolia, *Caesal pinia sappan and Terminalia chebula*

11. Strychnos *nuxvomica, Solanum trilobatum, Physalis, Aegle marmelos and Alpinia* **sp.,**

12. Anthocephalus Cadamba, Costus.

13. Production technology of aromatic crops-*Curcuma aromatic* **and C.** *caesia, Coleus aromaticus, Ocimum kilimanjaricum***,**

14. Bursera

15. National and International conservation network

16. Intellectual property rights issues

17. Processing and value addition, marketing in spices crops.

Practical schedule

1. Collection of endangered plant species

2. Establishment of endangered plant species

3-7. Alkaloid estimation

8. Essential oil extraction methods

9-10. Visit to related industries

11. Value added spice product

12-14. Harvesting and packaging techniques for minimal loss in medicinal crops.

15. Harvesting and packaging techniques for minimal loss in aromatic crops.

16-17 Harvesting and packaging techniques for minimal loss in spices crops.

Course Outcome

CO1: The students must be able to identify the RET medicinal plants and understand the problems in conservation

CO2: The student will develop skill in harvesting and packaging techniques for underutilized medicinal crops

CO - PSO - PO Mapping

	PSO1	PSO2	PSO3	PSO4	PO1	PO2	PO3	PO4	PO5	PO6
CO1	X		X	X	X	X	X	X	X	X
CO2	X	X	X	X	X	X	X	X	X	X

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PSM 625 PROCESSING OF PLANTATION, SPICE, MEDICINAL AND AROMATIC CROPS (2+1)

Learning Objectives

- **To facilitate deeper understanding on principles and practices of post harvest technology of plantation crops- spices- medicinal and aromatic crops.**
- **To gain knowledge on processing, Volatile oil extraction and value addition in plantation, spice, medicinal and aromatic crops.**

Theory

UNIT I Commerical uses of spices and plantation crops

Commercial uses of spices and plantation crops. processing of major spices - cardamom- black pepper- ginger- turmeric- chilli and paprika- vanilla- cinnamon- clove- nutmeg- allspice- coriander- fenugreek- curry leaf. extraction of oleoresin and essential oils.

UNIT II Processing of plantation crops

Processing of produce from plantation crops- viz. coconut- arecanut- cashewnut- oil palm- palmyrah- date palm- cocoa- tea- coffee- rubber etc.

UNIT III Processing of medicinal plants

Processing of medicinal plants– dioscorea- gloriosa- stevia- coleus- ashwagandha- tulsi- isabgol- safed musli- senna- aloe- catharanthus- etc. different methods of drying and storage.microbial contamination of stored product. influence of temperature and time combination on active principles.

UNIT IV Extraction and analysis of active principles

Extraction and analysis of active principles using TLC / HPLC / GC. distillation-solvent extraction from aromatic plants– davana- mint- rosemary- rose- citronella-lavender- jasmine- etc.

Unit V Processing technology II

Study of aroma compounds and value addition. Nano-processing technology in medicinal and aromatic plants.

Current Stream of Thought

Practical

Study of processing of different spices and plantation crops. study of processing of medicinal plants- their drying and storage. extraction of active ingredients from different spices and herbs using TLC- HPLC- GC/CG-MS technology. distillation-solvent extraction from aromatic plants – davana- mint- rosemary- citronella- lavender-jasmine- etc. identification of different odoriferous factors in essential oil with GLC/GCMS. physico-chemical and sensory evaluation of oils and oleoresin. value added products from spices and plantation crops.

Lecture schedule

Commercial uses of spices and plantation crops – extraction of oleoresin and essential oils – different methods of drying and storage – microbial contamination of stored product –extraction and analysis of active principles using TLC / HPLC /GC – Distillation- solvent extraction from spice crops.

1. Processing of produce from spice crops
2. Processing of produce from plantation crops
3. Processing of produce from medicinal crops
4. Cardamom
5. Black pepper
6. Ginger
7. Turmeric, Chilli and Paprika
8. Vanilla, Cinnamon, Clove, Nutmeg and Allspice
9. Coriander, Fenugreek and Curry leaf
10. Coconut
11. Arecanut
12. Cashewnut
13. Oil palm, Palmyrah
14. Date palm, cocoa, Tea, Coffee and Rubber
15. Dioscorea
16. Gloriosa
17. Mid semester examination
18. Stevia
19. Coleus, Ashwagandha
20. Tulsi, Isabgol
21. Safed musli Senna
22. Aloe, Catharanthus
23. Distillation and soivent extraction from aromatic plants
24. Davana
25. Mint
26. Rosemary
27. Rose
28. Citronella
29. Lavender
30. Jasmine
31-32 Study of aroma compounds and value addition
33-34. Nano – processing technology in medicinal and aromatic plants.

Practical schedule

1. Harvesting procedure and stages of harvesting spice crops.
1. Different processing technology in spice crops.
2. Preparation of value added products from spice crops.
3. Harvesting procedure and stages of harvesting plantation crops.
4. Different processing technology in plantation crops.
5. Preparation of value added products from plantation crops.
6. Harvesting procedure and stages of harvesting medicinal crops.
7. Different processing technology in medicinal crops.
8. Harvesting procedure and stages of harvesting aromatic crops.
10. Distillation and solvent extraction of essential oils from aromatic plants.
11. Identification of different odoriferous factors in essential oils.
12. Extraction of alkaloids from medicinal crops.
13. Sensory evaluation of oils and ole oleoresins.
14. Study of food standards. National and International standards.
15. Visit to processing units to study the layout, equipments, hygiene, sanitation and residual / waste management.
16-17. Project preparation to establish processing industry.

Course Outcome

CO1:The students will be able to demonstrate different methods of processing of different spices and plantation crops.
CO2: The student will develop skill in solvent extraction and distillation of essential oil from aromatic plants

CO - PSO - PO Mapping

	PSO1	PSO2	PSO3	PSO4	PO1	PO2	PO3	PO4	PO5	PO6
CO1	X	X	X	X	X	X		X	X	
CO2		X	X	X	X	X		X	X	

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OPC- HOR 711 PROPAGATION AND NURSERY MANAGEMENT OF HORTICULTURAL CROPS (2+1)

Learning Objectives

- **To make the students learn different methods of plant propagation.**
- **To impart knowledge on nursery management of various horticultural crops.**
- **To make them familiarize with the tools and implements essential for all horticultural operations.**

Theory

Unit I Principles of plant propagation

Sexual and asexual methods of propagation - principles and factors influencing seed germination-dormancy- hormonal regulation of germination and seedling growth- seed quality- packing- storage- certification and testing.

Unit II Anatomical and physiological aspects of plant propagation

Techniques of cottage - layerage- graftage and budding- compatibility- dwarfing rootstocks of important fruit trees.

Unit III Plant growth regulators and plant tissue culture

Role of PGR'S in plant propagation- role of nucellar embryony- apomixes- tissue culture techniques- hardening techniques .

Unit IV Planning of a nursery unit and modern propagation structures

Raising of nursery plants- selection- certification maintenance of mother plants and bud wood and root stock nurseries- use of modern structures- mist chambers- low cost poly houses- tunnel houses.

Unit V Marketing methods of nursery plants and economics

Media/soil mixtures- containers- use of machinaries- lifting- packing- transport-marketing- economics of raising nursery and management in different fruit crops.

Current Stream of Thought

Practical

Media/soil mixture- containers and soil sterilisation- use of chemicals for seed treatment and sowing- preparation of nursery beds- polybags- seedpans- thumb rule for raising seedlings- stratification and scarification of seeds and use of tetrazolium salts for germination tests-identification of nucellar seedlings- practice of different asexual methods of propagation- viz.-cuttage- layering- budding- approach- veneer and softwood grafting-use of plant growth regulators in propagation of plants -use of mist chambers- modern propagation structures- low cost polyhouses- low tunnels and bottom heating techniques- selection- lifting- packing- transportation and marketing of nursery plants- economics of raising nurseries- visit to local commercial/private nurseries.

Lecture schedule

1. **Scope and importance of plant propagation.**
2. **Study of sexual and asexual methods of propagation.**
3. **Advantages and disadvantages of seed and vegetative propagation.**
4. **Factors influencing seed germination of Horticultural crops.**
5. **Studies on dormancy, hormonal regulation of germination and seedling growth.**
6. **Study of seed quality, packing, storage, certification and testing.**
7. **Study of anatomical and physiological aspects of asexual propagation.**
8. **Studies on graft compatibility on fruit crops.**
9. **Dwarfing rootstocks of commercial importance in fruit crops.**
10. **Role of PGR's in raising seedlings and rooting of cuttings and layers.**
11. **Role of nucellar embryony and apomixis.**
12. **Studies on tissue culture techniques.**
13. **Micro grafting (STG).**
14. **Techniques of cuttings and layering.**
15. **Techniques of budding and grafting.**
16. **Planning of nursery unit.**
17. **Mid-semester examination**
18. **Study of raising of nursery plants and their after care- role of protray nursery and their after care.**
19. **Study of modern propagation structures.**
20. **Role of mist chambers in plant propagation.**
21. **Study of bottom heating techniques.**

22. Hardening techniques in nursery.
23. Progeny orchard and scion bank.
24. Establishment of bud wood bank.
25. Media -soil mixture preparation for nursery plants.
26. Study of containers used for nursery.
27. Use of machineries in nurseries.
28. Soil sterilization techniques.
29. Irrigation systems in nursery plants.
30. Lifting and packing of nursery plants.
31. Transportation and marketing of nursery plants.
32. Nursery planning and layout .
33. Economics of raising nursery and management of different fruit crops.
34. Nursery acts.

Practical schedule

1. Media/soil mixture, containers and soil sterilization.
2. Use of chemicals for seed treatment and sowing.
3. Preparation of nursery beds, polybags, seedpans, thumbrule for raising seedlings.
4. Stratification and scarification of seeds and use of tetrazolium salts for germination.
5. Identification of nucellar seedlings.
6. Practice of different asexual methods of propagation, viz.,cuttage, layering.
7. Buddingmethods.
8. Grafting- methods.
9. Use of plant growth regulators in propagation.
10. Role of mist chambers in plant propagation.
11. Other protected structures uses for plant propagation.
12. Low cost polyhouses, low tunnels.
13. Bottom heating techniques and soil sterilization.
14. Selection, lifting, packing of nursery plants.
15. Transportation and marketing of nursery plants.
16. Economics of raising nurseries.
17. Visit to local commercial/private nurseries.

Course Outcome

CO1- gain knowledge on physiology, principles, factors influencing, media and methods of propagation of Horticultural crops

CO2-gain skill in all propagation methods and technology for commercial scale adoption

CO3- become capable of managing commercial nursery business.

CO - PSO - PO Mapping

	PSO1	PSO2	PSO3	PSO4	PO1	PO2	PO3	PO4	PO5	PO6
CO1	X		X	X	X	X	X	X	X	X
CO2	X		X	X	X	X	X	X	X	X
CO3	X		X	X	X	X	X	X	X	X

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OPC-PSM 712# GENETIC RESOURCES AND CONSERVATION OF MEDICINAL AND AROMATIC PLANTS (2+1)

Learning Objectives

- **Understanding the principles of biodiversity- strategies in conservation and utilization of medicinal and aromatic plants**
- **To gain knowledge about biodiversity of under exploited medicinal and aromatic plants in India.**

Theory

Unit I Importance of biodiversity and methods of conservation

Biodiversity & conservation- issues and goals- centres of origin of cultivated medicinal and aromatic plants- primary and secondary centres of genetic diversity- present status of gene centers- exploration and collection of germplasm- conservation of genetic resources *in-situ* **&** *ex-situ* **germplasm conservation problem of recalcitrant seeds cold storage of scions- tissue culture cryopreservation- pollen and seed storage inventory of germplasm.**

Unit II Role of National institutes in conservation of plant quaran tine

Introduction of germplasm- plant quarantine- role of knowledge, role of national institutes is conservation- TBGRI- NBPGR etc. intellectual property rights- regulatory horticulture- plant variety protection authority- maintenance of core group using rational knowledge for plant conservation.

Unit III Bio diversity of medicinal plants -I

Senna- coleus- ashwagandha- glory lily- sarpagandha- dioscorea sp. aloevera- phyllanthus

Unit IV Bio diversity of medicinal plants –II

Kalmegh- medicinal solanum- gymnema- isabgol- ipecac- periwinkle- poppy- safed musli- stevia

Unit V Aromatic plants

Palmarosa- lemongrass- citronella- vettiver- geranium- mentha- artemisia- ocimum- eucalyptus- rosemary- thyme- patchouli- lavender- marjoram- oreganum.

Current Stream of Thought

Practical

Documentation of germplasm maintenance of passport data and other records of accessions; field exploration trips- exercise on *ex situ* **conservation; cold storage- pollen/seed storage- cryopreservation- visit to National Gene Bank and other centers of PGR activities.**

Lecture schedule

1. **Bio diversity – introduction- principles, goals and issues in conservation**
2. **Genetic diversity- occurrence and distribution**
3. **Exploration, collection, characterization, documentation and cataloging of germplasm**
4. **Present status of national and international gene banks**
5. **Role of national institutes in conservation-TBGRI, NBPGR.etc.**
6. **Germplasm exchange, Material Transfer Agreement and current quarantine protocols**
7. **Methods for** *ex situ* **conservation of germplasm and** *in situ* **conservation of germplasm**
8. **Use of GIS and documentation of local biodiversity**
9. **Horticultural cropping system and implication on biodiversity**
10. **Impact of climate change on biodiversity**
11. **Advances and issues in conservation of biodiversity through recalcitrant and orthodox seeds**
12. **Advances and issues in conservation of biodiversity through vegetative propagation**
13. **Intellectual Property Rights, Plant Variety Protection Authority**

14. **Status of biodiversity of coffee**
15. **Status of biodiversity of tea, cashew**
16. **Status of biodiversity of cocoa, rubber, palmyrah, oil palm, coconut and arecanut.**
17. **Mid-semester examination**
18. **Status of biodiversity of black pepper and cardamom**
19. **Status of biodiversity of ginger and turmeric**
20. **Status of biodiversity of coriander and fennel**
21. **Status of biodiversity of nutmeg and cinnamom**
22. **Status of biodiversity of Clove**
23. **Status of biodiversity of Aloe vera**
24. **Status of biodiversity of** *Coleus forskohlii and Dioscorea sp.*
25. **Status of biodiversity of** *Ocimum and Phyllanthus amarus*
26. **Status of biodiversity of Geranium and Vettiver**
27. **Status of biodiversity of Lemon grass**
28. **Status of biodiversity of Palmrosa and Citronella**
29. **Status of biodiversity of Eucalyptus, Artemisia and Mint.**
30. **Under exploited minor fruit crops - present status and scope**

31-34.Minor spices and Plantation crop - origin, distribution -biodiversity, propagation, conservation and utilization.

Practical schedule

1. **Field exploration trips- exercise in collection and characterization**
2. **Visit to field germplasm unit and documentation of germplasm**
3. **Practices in maintenance of passport data**
4. **Practical study of** *ex situ* **conservation methods**
5. **Practical study of** *in situ* **conservation methods**
6. **Methods of seed storage for short and long term conservation**
7. **Methods of conservation using vegetative propagules**
8. *In vitro* **conservation protocols**
9. **Study of species diversity in horticultural cropping system**
10. **Visit to regional conservation centres**
11. **Visit to subtropical and temperate zone medicinal & aromatic crop fields**
12. **Characterization of coffee germplasm**
13. **Characterization of cardamom germplasm**
14. **Characterization of Ocimum sp. germplasm**
15. **Identification of minor plantation and spices crops and their description.**
16. **Use of molecular tools for characterizing species diversity**
17. **Estimating extent of diversity through collection and analysis of data**

Course Outcome

CO1:The students will be able to identify the genetic resources of underutilized medicinal and aromatic plants

CO2;They will be able to demonstrate conservation techniques followed for underutilized medicinal and aromatic plants.

CO3;They will be able to identify underutilized minor medicinal crops.

CO - PSO - PO Mapping

	PSO1	PSO2	PSO3	PSO4	PO1	PO2	PO3	PO4	PO5	PO6
CO1	X		X	X	X	X		X	X	X
CO2	X		X	X	X	X		X	X	X
CO3	X		X	X	X	X		X	X	X

References

1. **Frankel, O.H. and J.G. Hawkes. 1975. Crop Genetic Resources for Today and Tomorrow. Cambridge University Press.UK.**
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