

ANNAMALAI UNIVERSITY

ANNAMALAINAGAR



M.Sc(Horticulture)

DEGREE PROGRAMMES

SYLLABUS

2012-2013

ANNAMALAI UNIVERSITY
FACULTY OF AGRICULTURE
M.Sc. (Horticulture) Degree Programme
(Regular and Part – time)

Rules and Regulations with effect from 2012-2013

1. Short title and commencement

- 1.1. These rules and regulations shall govern the post graduate studies leading to the award of degree of Master of Science (Horticulture) in the Faculty of Agriculture.
- 1.2 They shall come into force with effect from the academic year 2012 – 2013.

2. Definitions

- 2.1 An “Academic Year” shall consist of two semesters.
- 1.2 .“Semester” means an academic term consisting of 110 working days including final theory examinations.
- 1.3 “Subject” means a unit of instruction to be covered in a semester having specific No., title and credits.
- 1.4 “Credit hour” means, one hour lecture plus two hours of library or home work or two and half hours of laboratory/field practical per week in a semester.
- 1.5 “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.
- 1.6 “Credit Point” means the grade point multiplied by credit hours.
- 1.7 “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.
- 1.8 “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 upto 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 Department of Horticulture are as follows:

- a) Fruit Science
- b) Vegetable Science
- c) Floriculture and Landscape Gardening
- d) Plantation, Spices, Medicinal and Aromatic Crops

4. Eligibility for admission

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

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

B.Sc.(Ag.) / B.Sc.(Hort.) / B.Tech. (Hort.) / B.Sc. (Forestry) / B.Tech. (Agri. Biotech).

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 concerned.** 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 concerned** is required. **However, this will not apply to SC/ST candidates for whom a pass in the degree concerned 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

5.1. A. Full-Time Programme

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

5.1. B. Part-Time Programme

The duration for Part- time M.Sc. (Hort) programme will be of three years. Part- time students will be permitted to register up to a maximum of 11 credits per semester. The research credits will be offered from third semester. The distribution of research credits for the four semesters (Semester III to VI) will be the same as that of regular students. A student registered for Part- time M.Sc. (Hort) programme should complete the course within five years from the date of his 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
ii) Statistical methods and design of experiments	3
iii) Computer application for Agricultural Research	2
iv) Seminar	1
v) Research	20
Total credits	55

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

5.5 Non- credit compulsory courses

S.No.	Name of the Course	Department concerned
1.	Basic Concepts In Laboratory Techniques / Audio visual laboratory techniques* (0+1)	Soil science and Agricultural Chemistry Microbiology Plant breeding and Genetics * Agricultural Extension
2.	Technical writing and communication skills (0+1)	Parent Department and English
3.	Intellectual property and its management in agriculture(1+0) e-course	Agricultural Economics
4.	Library and Information services (0+1)	Library Sciences
5.	Disaster Management(1+0) e-course	Agronomy
6.	Agricultural Research Ethics and Methodology/Agricultural research, research ethics and rural development programmes * (0+1)	Parent department * Agricultural Extension

5.4. Minimum Grade point requirement

A post graduate student should maintain a minimum Grade Point of 6.00 out of 10 to secure a pass in a subject. In the subjects in which a student fails, he/she has to reappear for the examination to get a pass in that subject. Overall Grade Point Average (OGPA) of 6.50 out of 10 is required to secure a degree.

6. Attendance requirement

6.1. "One hundred per cent attendance is expected of each student. A student, who fails to secure a minimum of 75 per cent of attendance in each subject separately for theory and practicals, 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, the attendance will be calculated from the date of joining of the student who are permitted to join late due to administrative reasons. However, for genuine reasons, condonation of attendance deficiency may be considered by the Vice-Chancellor on

the recommendation of the Head of the Department and 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.
- 6.3 In respect of the student who had absented for the Mid-Semester Examination (MSE) on University business with prior permission of the Head of the Department /Dean, Faculty of Agriculture, the makeup MSE should be conducted ordinarily within 15 working days from the date of conduct of the Mid-Semester Examinations.
- 6.4 The students who absent for Mid Semester Examination in a subject on genuine reasons shall be permitted to write the makeup MSE after payment of Rs. 500/- or the amount prescribed by the University.

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 of Faculty of Agriculture 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. Major Adviser (Chairman)

Every student shall have a Major Adviser who will be from his/her major field of studies. The appointment of Major Advisers (Chairman) shall be made by the Head of the Department concerned. 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.

7.3. Guidelines on the duties of the Advisory Committee

- i) Guiding students in drawing the outline of research work
- ii) Guidance throughout the programme of study of the students.
- iii) Evaluation of research and seminar credits.
- iv) Correction and finalization of thesis draft.
- v) Conduct of final Viva-Voce examination.
- vi) The proceedings of the Advisory Committee will be sent to the Head of the Department concerned within 10 working days.
- vii) Periodical review of the Advisory Committee proceedings will be made by the Head of the Department concerned.

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 Concerned by the end of the first semester.

9 . Evaluation of students' performance

9.1 The duration of Mid-Semester Examination (MSE) should be of one hour. The duration of the final theory and final practical examinations shall be three hours each.

9.2. Grading

- i) Every teacher handling a subject shall conduct Mid-Semester Examination (MSE) as per the scheme drawn by Head of the Department Concerned, evaluate and send the marks obtained by the students to the Controller of Examinations through the Head of the Department Concerned within seven working days.
- ii) There will be final examinations separately for theory and practical which will be conducted by the University.
- iii) Each final examination will be evaluated by two examiners (one internal and one external). The practical examination will be conducted and evaluated by two examiners (one internal and one external).
- iv) The distribution of marks will be as indicated below.

Test	Courses with Practical and Theory	Courses without Practical	Courses without Theory
Mid-Semester	20 Theory only	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 and final theory examinations are as follows.

Mid-Semester

For Subjects with practical's (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

Final Theory

For subjects with practical's (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	(5x5)	25 marks

- v) The student should secure a minimum of 60 per cent marks separately in theory and practical and also in aggregate to secure a pass in the subject.
- vi) 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 a 10 point scale up to two decimals.
- vii) Students who secure marks below 60 per cent in a subject will be awarded 'F' grade. The supplementary examinations for the candidates who fail in a subject or subjects will be held in the subsequent semester.
- viii) Students who did not have the required minimum attendance of 75 per cent will be awarded 'E' grade and has to repeat the subject.

9.3. Non- Credit Compulsory Subject

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 register and present a seminar of 0+1 credit.

10.1 a. The seminar topic should be only from the major field and should not be related to the area of thesis research.

10.1. b. 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 concerned 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 containing not less than 25 typed/printed pages with a minimum number of 50 references covering the recent 10 years time 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 of the Department concerned.

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. The student will submit 2 copies of the corrected manuscript to the Head of the Department Concerned 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 concerned 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 will be evaluated and Grade Point awarded by the Head of the Department concerned 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 practicals. 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. Research work

12.1. 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 concerned. 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.

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

I Semester	0+ 2
II Semester	0+ 4
III Semester	0+ 6
IV Semester	0+ 6
	0+ 2 (Thesis Viva-Voce)
Total	0 + 20

12.3. 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.

- 12.4. Before the end of the semester the Advisory Committee should evaluate the work and award Grade Point depending upon the quality and quantity of work done by him/her with reference to the approved programme during the semester.
- 12.5. Attendance register must be maintained for the research students by the Chairman while monitoring his/her research programme.
- 12.6. The procedure for evaluation of research under different situations are explained hereunder.

Situation - 1

The student should complete the research work as prescribed by the Advisory Committee.

Grade Point shall be awarded as evaluated by the Advisory Committee.

The student can be permitted to work for fresh research credits in the following semester.

Situation - 2

- The student who does not satisfy the required 75 per cent attendance shall be awarded grade 'E'.
- The student who could not complete the research work for reasons found satisfactory to the Advisory Committee shall be awarded the grade 'EE'
- The student has to reregister the same block of research credits for which 'E / EE' grade was awarded in the following semester.
- The student should not be allowed to register for fresh (first time) research credits.

Situation – 3

The student who fails to complete the research work after repeating the registration for the second time shall be awarded grade 'EE'.

- In the mark sheet the registration for '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 Concerned.

13. Other regulations.

- 13.1. The valued answer books of each Mid-Semester Examination shall be returned to the student for his/her information and guidance within seven days from the date of examination.
- 13.2. 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.
- 13.3. At the end of each semester, the student will be given the mark list.

14. Thesis

14.1. 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.

14.2. Evaluation of thesis

The students completing the thesis work to the satisfaction of the Advisory Committee should submit two copies of the thesis in paper pack within four weeks from the last working day of the semester.

The students who could not submit the thesis in the final form within four weeks will be awarded 'EE' grade and he/she has to re-register in the next semester. 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 in consultation with the Head of the Department. The external examiner will send the evaluation report separately to the Controller of Examinations. If the report is favourable, Viva-Voce will be arranged by the Head of the Department concerned and conducted by the Advisory Committee, Head of the Department concerned and the external examiner who may preferably be the same who evaluated the thesis. The Head of the Department shall send the recommendations of the examining committee to the Controller of Examinations. On the unanimous recommendation of the committee and with the approval of the University, the degree shall be awarded to the candidate.

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

14.2.2. 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.

14.2.3. After the successful completion of thesis Viva-Voce, the student has to submit 4 bound copies of the corrected thesis (one each for Department Library, Faculty Library Chairman and the student), 3 copies of abstract of thesis, 2 copies of the summary of the findings both in Tamil and English (in 10-15 lines) and also in C.D. form.

14.2.4. The student should submit 4 copies of thesis after completion of thesis Viva-Voce within the time as specified by the Head of the Department. In case of failure to submit, the student will be awarded EE grade for final Viva-Voce evaluation credits (0+2).

15. 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.

M.Sc. (Horticulture) Degree Programmes
M.Sc. (Hort.) Fruit Science

S.No.	Code. No.	Major courses	Credit hours
1.	FSC 611*	Tropical and dry land fruit production*	2+1
2.	FSC 621*	Sub tropical and temperate fruit production*	2+1
3.	FSC 623*	Biodiversity and conservation of fruit crops*	2+1
4.	FSC 711*	Breeding of fruit crops*	2+1
5.	HOR 611	Biotechnology of horticultural crops	2+1
6.	HOR 612	Growth and development of horticultural crops	2+1
7.	HOR 613	Methods of breeding of horticultural crops	2+1
8.	HOR 711	Protected cultivation and precision horticulture	1+1
9.	HOR 712	Urban and environment horticulture	1+1
10.	HOR 721	Post harvest technology of horticultural crops	2+1
11.	HOR 614**	Research Ethics and Methodology **	0+1
		Restricted to	20
		Minor courses	
1.		From Other Departments	2+1
2.		From Other Departments	2+1
3.		From Other Departments	2+1
		Total	09
		Supporting courses	
1.	STA 614	Statistical methods and design of experiments	2+1
2.	COM 615	Computer applications for agricultural research	1+1
		Total	3 + 2 = 5
1.	FSC 713	Seminar	1+0 = 1
2.	FSC 612,622, 712,722&723	Research and thesis viva-voce	0+20 = 20
		Total Credits	55
		Non- credit compulsory courses	
1.	PGS 611**	Basic concepts in laboratory techniques	0+1
2.	PGS 622**	Technical writing and communication skills	0+1
3.	PGS 623** (e-course)	Intellectual property rights and its management in agriculture	1+0
4.	PGS 714**	Library and information services	0+1
5.	PGS 725** (e-course)	Disaster management	1+0

***Compulsory course** Non credit compulsory course**

SEMESTER WISE DISTRIBUTION
M.Sc. (Hort.) Fruit Science - (Full Time)
Semester I

S. No.	Code No.	Courses	Credit Hours
Major Courses			
1.	FSC 611*	Tropical and dry land fruit production*	2+1
2.	HOR 611 HOR 612 HOR 613	Biotechnology of horticultural crops Growth and development of horticultural crops Methods of breeding of horticultural crops	2+1
		Total	4+2=6
Supporting courses			
3.	STA 614	Statistical methods and design of experiments	2+1
4.	COM 615	Computer applications for agricultural research	1+1
		Total	3+2= 5
5.	FSC 612	Research	0+2=2
		Total	7+6=13
Non- credit compulsory course			
6.	HOR 614**	Research Ethics and Methodology **	0+1
7.	PGS 611**	Basic concepts in laboratory techniques**	0+1

Semester II

S. No.	Code No.	Courses	Credit Hours
Major Courses			
1.	FSC 621*	Sub tropical and temperate fruit production*	2+1
2.	FSC 623*	Biodiversity and conservation of fruit crops*	2+1
		Total	4+2=6
3.		Minor courses(From Other Departments)	2+1=3
4.	FSC 622	Research	0+4=4
		Total	6+7=13
Non- credit compulsory course			
5.	PGS 622**	Technical writing and communication skills**	0+1
6.	PGS 623** (e-course)	Intellectual property rights and its management in agriculture**	1+0

***Compulsory course ** Non credit compulsory course**

Semester III

S. No.	Code No.	Courses	Credit Hours
Major courses			
1.	FSC 711*	Breeding of fruit crops*	2+1
2.	HOR 711 HOR 712	Protected cultivation and precision horticulture Urban and environment horticulture	1+1
			Total
			3+2=5
3.		Minor course 1(From Other Departments)	2+1=3
4.		Minor course 2(From Other Departments)	2+1=3
			Total
			4+2=6
5.	FSC 712	Research	0+6
6.	FSC 713	Seminar	0+1
			Total
			7+11=18
Non- credit compulsory course			
7.	PGS 714**	Library and Information services**	0+1

Semester IV

S. No.	Code No.	Courses	Credit Hours
Major courses			
1.	HOR 721	Post harvest technology of horticultural crops	2+1
2.	FSC 722	Research	0+6
3.	FSC 723	Thesis viva-voce	0+2
			Total
			2+9=11
Non- credit compulsory course			
4.	PGS 725** (e-course)	Disaster management**	1+0

***Compulsory course**

**** Non credit compulsory course**

Semester	Credits
Semester I	7+6=13
Semester II	6+7=13
Semester III	7+11=18
Semester IV	2+9=11
Total	22+33=55

SEMESTER WISE DISTRIBUTION
M.Sc. (Hort.) Fruit Science - (Part Time)
Semester I (PT)

S. No.	Code No.	Courses	Credit Hours
Major courses			
1.	FSC 611*	Tropical and dry land fruit production*	2+1
2.	HOR 611 HOR 612 HOR 613	Biotechnology of horticultural crops Growth and development of horticultural crops Methods of breeding of horticultural crops	2+1
Total			4+2=6
Supporting courses			
3.	STA 614	Statistical methods and design of experiments	2+1=3
Grand Total			6+3=09
Non- credit compulsory course			
5.	HOR 614**	Research Ethics and methodology**	0+1
6.	PGS 611**	Basic concepts in laboratory techniques**	0+1

Semester II (PT)

S. No.	Code No.	Courses	Credit Hours
Major courses			
1.	FSC 621*	Sub tropical and temperate fruit production*	2+1
2.	FSC 623*	Biodiversity and conservation of fruit crops*	2+1
Total			4+2=6
3.	Minor course(From Other Departments)		2+1=3
Total			6+3=09
Non- credit compulsory course			
4.	PGS 622**	Technical writing and communication skills**	0+1
5.	PGS 623** (e-course)	Intellectual property rights and its management in agriculture**	1+0

Semester III (PT)

S. No.	Code No.	Courses	Credit Hours
Major courses			
1.	FSC 711*	Breeding of fruit crops*	2+1=3
2.	Minor course (From Other Departments)		2+1=3
Supporting course			
3.	COM 615	Computer applications for agricultural research	1+1=2
4.	FSC 612	Research	0+2=2
5.	FSC 713	Seminar	0+1=1
Total			5+6=11
Non- credit compulsory course			
6.	PGS 714**	Library and Information services**	0+1

***Compulsory course ** Non credit compulsory course**

Semester IV (PT)

S. No.	Code No.	Courses	Credit Hours
Major course			
1.	HOR 721	Post harvest technology of horticultural crops	2+1
2.	FSC 622	Research	0+4
Total			2+5=07
Non- credit compulsory course			
3.	PGS 725** (e-course)	Disaster management**	1+0

Semester V (PT)

S. No.	Code No.	Courses	Credit Hours
Major courses			
1.	HOR 711 HOR 712	Protected cultivation and precision horticulture Urban and environment horticulture	1+1=2
Minor course (From Other Departments)			2+1=3
2.	FSC 712	Research	0+6=6
Total			3+8=11

Semester VI (PT)

S. No.	Code No.	Courses	Credit Hours
1.	FSC 722	Research	0+6=6
2.	FSC 723	Thesis viva-voce	0+2=2
Total			0+8=8

***Compulsory course** Non credit compulsory course**

Semester	Credits
Semester I	6+3=9
Semester II	6+3=9
Semester III	5+6=11
Semester IV	2+5=7
Semester V	3+8=11
Semester VI	0+8=8
Total	22+33=55

**M.Sc. (Hort.) Degree Programmes
Vegetable Science - 2012**

S.No.	Code. No.	Major courses	Credit hours
1.	VSC 611*	Production technology of cool season vegetable crops *	2+1
2.	VSC 621*	Production technology of warm season vegetable * crops	2+1
3.	VSC 623*	Systematics of vegetable crops *	2+1
4.	VSC 711*	Breeding of vegetable crops	2+1
5.	HOR 611	Biotechnology of horticultural crops	2+1
6.	HOR 612	Growth and development of horticultural crops	2+1
7.	HOR 613	Methods of breeding of horticultural crops	2+1
8.	HOR 711	Protected cultivation and precision horticulture	1+1
9.	HOR 712	Urban and environment horticulture	1+1
10.	HOR 721	Post harvest technology of horticultural crops	2+1
11.	HOR 614**	Research Ethics and Methodology **	0+1
		Restricted to	20
		Minor courses	
1.		From Other Departments	2+1
2.		From Other Departments	2+1
3.		From Other Departments	2+1
		Total	09
		Supporting courses	
1.	STA 614	Statistical methods and design of experiments	2+1
2.	COM	Computer applications for agricultural research	1+1
3.		Total	3 + 2 = 5
4.	VSC 713	Seminar	1+0 = 1
5.	VSC 12,622, 712&722,723	Research	0+20 = 20
6.		Total	55
7.		Non- credit compulsory courses	
8.	PGS 611**	Basic concepts in laboratory techniques	0+1
9.	PGS 622**	Technical writing and communication skills	0+1
10.	PGS 623** (e-course)	Intellectual property rights and its management in agriculture	1+0
11.	PGS 714**	Library and information services	0+1
12.	PGS 725** (e-course)	Disaster management	1+0

*Compulsory course ** Noncredit compulsory course

SEMESTER WISE DISTRIBUTION
M.Sc. (Hort.) Vegetable Science - (Full Time)
Semester I

S. No.	Code No.	Major Courses	Credit Hours
1.	VSC 611*	Production technology of cool season vegetable crops *	2+1
2.	HOR 611 HOR 612 HOR 613	Biotechnology of horticultural crops Growth and development of horticultural crops Methods of breeding of horticultural crops	2+1
		Total	4+2=6
		Supporting courses	
3.	STA 614	Statistical methods and design of experiments	2+1
4.	COM 615	Computer applications for agricultural research	1+1
		Total	3+2= 5
5.	VSC 612	Research	0+2
		Total	7+6=13
		Non- credit compulsory course	
6.	HOR 614**	Research Ethics and Methodology **	0+1
7.	PGS 611**	Basic concepts in laboratory techniques**	0+1

Semester II

S. No.	Code No.	Major Courses	Credit Hours
1.	VSC 621*	Production technology of warm season vegetable crops*	2+1
2.	VSC 623*	Systematics of vegetable crops *	2+1
		Total	4+2=6
3.		Minor course (From Other Departments)	2+1=3
4.	VSC 622	Research	0+4=4
		Total	6+7=13
		Non- credit compulsory course	
5.	PGS 622**	Technical writing and communication skills**	0+1
6.	PGS 623** (e-course)	Intellectual property rights and its management in agriculture**	1+0

***Compulsory course ** Non-credit compulsory course**

Semester III

S. No.	Code No.	Major Courses	Credit Hours
1.	VSC 711*	Breeding of vegetable crops	2+1
2.	HOR 711 HOR 712	Protected cultivation and precision horticulture Urban and environment horticulture	1+1
		Total	3+2=5
3.		Minor course 1 (From Other Departments)	2+1=3
4.		Minor course 2 (From Other Departments)	2+1=3
		Total	4+2=6
5.	VSC 712	Research	0+6
6.	VSC 713	Seminar	0+1
		Total	7+11=18
		Non- credit compulsory course	
7.	PGS 714**	Library and information services**	0+1

Semester IV

S. No.	Code No.	Major Courses	Credit Hours
1	HOR 721	Post harvest technology of horticultural crops	2+1
2	VSC 722	Research	0+6
3.	VSC 723	Thesis viva –voce	0+2
		Total	2+9=11
		Non- credit compulsory course	
4.	PGS 725** (e-course)	Disaster management**	1+0

***Compulsory course**

**** Non credit compulsory course**

Semester	Credits
Semester I	7+6=13
Semester II	6+7=13
Semester III	7+11=18
Semester IV	2+9=11
Total	22+33=55

M.Sc(Hort.) Vegetable Science
Semester Wise Distribution
(Part Time)
Semester I (PT)

S. No.	Code No.	Major Courses	Credit Hours
1.	VSC 611*	Production technology of cool season vegetable crops *	2+1
2.	HOR 611 HOR 612 HOR 613	Biotechnology of horticultural crops Growth and development of horticultural crops Methods of breeding of horticultural crops	2+1
		Total	4+2=6
		Supporting course	
3.	STA 614	Statistical methods and design of experiments	2+1=3
		Total	6+3=9
		Non- credit compulsory course	
4.	HOR 614**	Research Ethics and Methodology **	0+1
5.	PGS 611**	Basic concepts in laboratory techniques**	0+1

Semester II (PT)

S. No.	Code No.	Major Courses	Credit Hours
1.	VSC 621*	Production technology of warm season vegetable crops*	2+1
2.	VSC 623*	Systematics of vegetable crops *	2+1
		Total	4+2=6
3.		Minor course (From Other Departments)	2+1=3
		Total	6+3=9
		Non- credit compulsory course	
4.	PGS 622**	Technical writing and communication skills**	0+1
5.	PGS 623** (e-course)	Intellectual property rights and its management in agriculture**	1+0

***Compulsory course ** Non credit compulsory course**

Semester III (PT)

S. No.	Code No.	Major Course	Credit Hours
1.	VSC 711*	Breeding of vegetable crops	2+1
2.		Minor course (From Other Departments)	2+1=3
		Supporting Course	
3.	COM 615	Computer applications for agricultural research	1+1=2
4.	VSC 612	Research	0+2=2
5.	VSC 713	Seminar	0+1=1
		Total	5+6=11
		Non- credit compulsory course	
6.	PGS 714**	Library and information services**	0+1

Semester IV (PT)

S. No.	Code No.	Major Course	Credit Hours
1.	HOR 721	Post harvest technology of horticultural crops	2+1
2.	VSC 622	Research	0+4
		Total	2+5=07
		Non- credit compulsory course	
3.	PGS 725** (e-course)	Disaster management**	1+0

Semester V (PT)

S. No.	Code No.	Major Course	Credit Hours
1.	HOR 711 HOR 712	Protected cultivation and precision horticulture Urban and environment horticulture	1+1=2
2.		Minor course	2+1=3
3.	VSC 712	Research	0+6=6
		Total	3+8=11

Semester VI (PT)

S. No.	Code No.	Courses	Credit Hours
1.	VSC 722	Research	0+6=6
2.	VSC 723	Thesis viva voce	0+2=2
		Total	0+8=8

***Compulsory course** Non credit compulsory course**

Semester	Credits
Semester I	6+3=9
Semester II	6+3=9
Semester III	5+6=11
Semester IV	2+5=7
Semester V	3+8=11
Semester VI	0+8=8
Total	22+33=55

**M.Sc. (Hort.) Degree Programmes
Floriculture and Landscape gardening - 2012**

S.No.	Code. No.	Major courses	Credit hours
1.	FLG 611*	Production technology of loose flowers *	2+1
2.	FLG621*	Production technology of cut flowers *	2+1
3.	FLG 623*	Breeding of flower crops and ornamental plants *	2+1
4.	FLG 711*	Landscaping and ornamental gardening *	2+1
5.	HOR 611	Biotechnology of horticultural crops	2+1
6.	HOR 612	Growth and development of horticultural crops	2+1
7.	HOR 613	Methods of breeding horticultural crops	2+1
8.	HOR 711	Protected and precession horticulture	1+1
9.	HOR 712	Urban and environment horticulture	1+1
10.	HOR 721	Post harvest technology of horticultural crops	2+1
11.	HOR 614	Research methodology	(0+1)
		Restricted to	20
		Minor courses	
1.		From Other Departments	2+1
2.		From Other Departments	2+1
3.		From Other Departments	2+1
		Total	09
		Supporting courses	
1.	STA 614	Statistical methods and design of experiments	2+1
2.	COM 615	Computer applications for agricultural research	1+1
3.		Total	3 + 2 5
4.	FLG 713	Seminar	1+0 1
5.	FLG 612,622, 712&722	Research	0+20 20
		Total Credits	55
		Non- credit compulsory courses	
1.	PGS 611**	Basic concepts in laboratory techniques	0+1
2.	PGS 622**	Technical writing and communication skills	0+1
3.	PGS 623** (e-course)	Intellectual property rights and its management in agriculture	1+0
4.	PGS 714**	Library and information services	0+1
5.	PGS 725** (e-course)	Disaster management	1+0

*Compulsory course

** Non credit Compulsory course

**Floriculture and Landscape gardening
Semestre-Wise Distribution
(Full Time)
Semester I**

S. No.	Code No.	Courses	Credit Hours
1	FLG 611*	Production technology of loose flowers *	2+1
2	HOR 611 HOR 612 HOR 613	Biotechnology of horticultural crops Growth and development of horticultural crops Methods of breeding horticultural crops	2+1
		Total	4+2=6
		Supporting courses	
3	STA 614	Statistical methods and design of experiments	2+1
4	COM 615	Computer applications for agricultural research	1+1
		Total	3+2= 5
5	FLG 612	Research	0+2
		Grand Total	7+6=13
		Non- credit compulsory course	
6	HOR 614**	Research Ethics and Methodology **	0+1
7	PGS 611**	Basic concepts in laboratory techniques**	(0+1)

Semester II

S. No.	Code No.	Courses	Credit Hours
1	FLG621*	Production technology of cut flowers *	2+1
2	FLG 623*	Breeding of flower crops and ornamental plants *	2+1
		Total	4+2=6
3		Minor courses	2+1=3
4	FLG 622	Research	0+4=4
		Total	6+7=13
		Non- credit compulsory course	
5	PGS 622**	Technical writing and communication skills**	(0+1)
6	PGS 623** (e-course)	Intellectual property rights and its management in agriculture**	(1+0)

***Compulsory course ** Non credit Compulsory course**

Semester III

S. No.	Code No.	Courses	Credit Hours
1	FLG 711*	Landscaping and Ornamental Gardening *	2+1
2	HOR 711 HOR 712	Protected and Precession Horticulture Urban and Environment Horticulture	1+1
		Major course Total	3+2=5
3		Minor courses 1	2+1=3
4		Minor course 2	2+1=3
		Total	4+2=6
5	FLG 712	Research	0+6
6	FLG 713	Seminar	0+1
		Total	7+11=18
		Non- credit compulsory course	
7	PGS 714**	Library and Information services**	(0+1)

Semester IV

S. No.	Code No.	Courses	Credit Hours
1	HOR 721	Post Harvest Technology of Horticultural Crops	2+1
2	FLG 722	Research	0+6
3	FLG 723	Thesis viva –voce	0+2
		Total	2+9=11
		Non- credit compulsory course	
4	PGS 725** (e-course)	Disaster Management**	(0+1)

*Compulsory course

** Non credit Compulsory course

Semesters	Credits
Semester I	7+6=13
Semester II	6+7=13
Semester III	7+11=18
Semester IV	2+9=11
Total	22+33=55

M.Sc. (Hort.) Floriculture and Landscape gardening – 2012
Semestre-Wise Distribution
(Part Time)
Semester I (PT)

S. No.	Code No.	Courses	Credit Hours
1	FLG 611*	Production technology of loose flowers *	2+1
2	HOR 611 HOR 612 HOR 613	Biotechnology of horticultural crops Growth and development of horticultural crops Methods of breeding horticultural crops	2+1
		Major course Total	4+2=6
		Supporting courses	
3	STA 614	Statistical methods and design of experiments	2+1=3
		Total	6+3=09
		Non- credit compulsory course	
5	HOR 614**	Research Ethics and Methodology **	0+1
6	PGS 611**	Basic concepts in laboratory techniques**	(0+1)

Semester II(PT)

S. No.	Code No.	Courses	Credit Hours
1	FLG621*	Production technology of Cut Flowers *	2+1
2	FLG 623*	Breeding of flower crops and Ornamental plants *	2+1
		Major course Total	4+2=6
3		Minor courses	2+1=3
		Total	6+3=09
		Non- credit compulsory course	
5	PGS 622**	Technical writing and communication skills**	(0+1)
6	PGS 623** (e-course)	Intellectual property right and its management in agriculture**	(1+0)

***Compulsory course ** Non credit Compulsory course**

Semester III (PT)

S. No.	Code No.	Courses	Credit Hours
1	FLG 711*	Landscaping and Ornamental Gardening *	2+1=3
2		Minor course	2+1=3
		Supporting Course	
3	COM 615	Computer Programming and Its Applications s	1+1=2
4	FLG 612	Research	0+2=2
5	FLG 713	Seminar	0+1=1
		Total	5+6=11
		Non- credit compulsory course	
6	PGS 714**	Library and Information services**	(0+1)

Semester IV (PT)

S. No.	Code No.	Courses	Credit Hours
1	HOR 721	Post Harvest Technology of Horticultural Crops	2+1
2	FLG 622	Research	0+4
		Total	2+5=07
		Non- credit compulsory course	
3	PGS 725** (e-course)	Disaster Management**	(0+1)

Semester V (PT)

S. No.	Code No.	Courses	Credit Hours
1	HOR 711 HOR 712	Protected and Precession Horticulture Urban and Environment Horticulture	1+1=2
		Minor course	2+1=3
2	FLG 712	Research	0+6=6
		Total	3+8=11

Semester VI (PT)

S. No.	Code No.	Courses	Credit Hours
1	FLG 722	Research(6+2)	0+8=8
		Total	0+8=8

***Compulsory course** Non credit Compulsory course**

Semesters	Credits
Semester I	6+3=09
Semester II	6+3=09
Semester III	5+6=11
Semester IV	2+5=07
Semester V	3+8=11
Semester VI	0+8=8
Total	22+33=55

M.Sc. (Hort.) Degree Programmes

M.Sc. (Hort.) in Plantation, Spice, Medicinal and Aromatic crops - 2012

S.No.	Code. No.	Major courses	Credit hours
12.	PSM 611*	Production technology of plantation crops *	2+1
13.	PSM 621*	Production technology of spice crops *	2+1
14.	PSM 623*	Production technology of medicinal and aromatic crops *	2+1
15.	PSM 711*	Breeding of plantation, spice, medicinal and aromatic crops	2+1
16.	HOR 611	Biotechnology of horticultural crops	2+1
17.	HOR 612	Growth and development of horticultural crops	2+1
18.	HOR 613	Methods of breeding of horticultural crops	2+1
19.	HOR 711	Protected cultivation and precision horticulture	1+1
20.	HOR 712	Urban and Environment Horticulture	1+1
21.	HOR 721	Post harvest technology of horticultural crops	2+1
22.	HOR 614**	Research Ethics and Methodology **	0+1
		Restricted to	20
		Minor courses	
4.		From Other Departments	2+1
5.		From Other Departments	2+1
6.		From Other Departments	2+1
		Total	09
		Supporting courses	
3.	STA 71	Statistical methods and design of experiments	2+1
4.	COM	Computer applications in agricultural research	1+1
		Total	3 + 2 5
3.	PSM 713	Seminar	1+0 1
4.	PSM 612,622, 712&722,723	Research	20
		Total Credits	55
		Non- credit compulsory courses	
6.	PGS 611**	Basic concepts in laboratory techniques	0+1
7.	PGS 622**	Technical writing and communication skills	0+1
8.	PGS 623** (e-course)	Intellectual property rights and its management in agriculture	1+0
9.	PGS 714**	Library and Information services	0+1
10.	PGS 725** (e-course)	Disaster Management	1+0

*Compulsory course ** Non credit compulsory course

M.Sc. (Hort.) Plantation, Spice, Medicinal and Aromatic crops
Semester-Wise Distribution(Full Time)
Semester I

S. No.	Code No.	Major Courses	Credit Hours
1.	PSM 611*	Production technology of plantation crops *	2+1
2.	HOR 611 HOR 612 HOR 613	Biotechnology of horticultural crops Growth and development of horticultural crops Methods of breeding of horticultural crops	2+1
		Total	4+2=6
		Supporting courses	
3.	STA 614	Statistical methods and design of experiments	2+1
4.	COM 615	Computer applications for agricultural research	1+1
		Total	3+2= 5
5.	PSM 612	Research	0+2
		Total	7+6=13
		Non- credit compulsory course	
6.	HOR 614**	Research Ethics and Methodology **	0+1
7.	PGS 611**	Basic concepts in laboratory techniques**	0+1

Semester II

S. No.	Code No.	Major Courses	Credit Hours
1.	PSM 621*	Production technology of spice crops *	2+1
2.	PSM 623*	Production technology of medicinal and aromatic crops *	2+1
		Total	4+2=6
3.		Minor courses	
4.	PSM 622	Research	0+4=4
		Total	6+7=13
		Non- credit compulsory course	
5.	PGS 622**	Technical writing and communication skills**	0+1
6.	PGS 623** (e-course)	Intellectual property rights and its management in agriculture**	1+0

***Compulsory course ** Non credit compulsory course**

Semester III

S. No.	Code No.	Major Courses	Credit Hours
1.	PSM 711*	Breeding of Plantation, spice, medicinal and aromatic crops	2+1
2.	HOR 711 HOR 712	Protected cultivation and Precession horticulture Urban and environment horticulture	1+1
		Total	3+2=5
		Minor courses	
3.		Minor course 1	2+1=3
4.		Minor course 2	2+1=3
		Total	4+2=6
5.	PSM 712	Research	0+6
6.	PSM 713	Seminar	0+1
		Total	7+11=18
		Non- credit compulsory course	
7.	PGS 714**	Library and information services**	(0+1)

Semester IV

S. No.	Code No.	Courses	Credit Hours
1.	HOR 721	Post harvest technology of horticultural crops	2+1
2.	PSM 722	Research	0+6
3.	PSM 723	Thesis viva voce	0+2
		Total	2+9=11
		Non- credit compulsory course	
4	PGS 725** (e-course)	Disaster management**	0+1

*Compulsory course

** Non credit Compulsory course

Semester	Credits
Semester I	7+6=13
Semester II	6+7=13
Semester III	7+11=18
Semester IV	2+9=11
Total	22+33=55

**Semester-Wise Distribution
(Part Time)
Semester I (PT)**

S. No.	Code No.	Major Courses	Credit Hours
1.	PSM 611*	Production technology of plantation crops *	2+1
2.	HOR 611 HOR 612 HOR 613	Biotechnology of horticultural crops Growth and development of horticultural crops Methods of breeding of horticultural Crops	2+1
		Total	4+2=6
		Supporting courses	
3.	STA 614	Statistical methods and design of experiments	2+1=3
		Total	6+3=09
		Non- credit compulsory course	
4.	HOR 614**	Research Ethics and Methodology **	0+1
5.	PGS 611**	Basic concepts in laboratory techniques**	(0+1)

Semester II(PT)

S. No.	Code No.	Major Courses	Credit Hours
1.	PSM 621*	Production technology of spice crops *	2+1
2.	PSM 623*	Production technology of medicinal and aromatic crops *	2+1
		Total	4+2=6
3.		Minor course	2+1=3
		Total	6+3=09
		Non- credit compulsory course	
4.	PGS 622**	Technical writing and communication skills**	0+1
5.	PGS 623** (e-course)	Intellectual property rights and its management in agriculture**	1+0

Semester III (PT)

S. No.	Code No.	Courses	Credit Hours
1.	PSM 711*	Breeding of plantation, spice, medicinal and aromatic crops	2+1
2.		Minor course	2+1=3
		Supporting Course	
3.	COM 615	Computer applications in agricultural research	1+1=2
4.	PSM 612	Research	0+2=2
5.	PSM 713	Seminar	0+1=1
		Total	5+6=11
		Non- credit compulsory course	
6.	PGS 714**	Library and information services**	0+1

***Compulsory course ** Non credit compulsory course**

Semester IV (PT)

S. No.	Code No.	Major courses	Credit Hours
1.	HOR 721	Post harvest technology of horticultural crops	2+1
2.	PSM 622	Research	0+4
		Total	2+5=07
		Non- credit compulsory course	
3.	PGS 725** (e-course)	Disaster management**	(0+1)

Semester V (PT)

S. No.	Code No.	Major courses	Credit Hours
1.	HOR 711 HOR 712	Protected cultivation and precision horticulture Urban and environment horticulture	1+1=2
2.		Minor course	2+1=3
3.	FSC 712	Research	0+6=6
		Total	3+8=11

Semester VI (PT)

S. No.	Code No.	Courses	Credit Hours
1.	FSC 722	Research	0+6=6
2.	FSC 723	Research	0+2=2
		Total	0+8=8

***Compulsory course** Non credit Compulsory course**

Semesters	Credits
Semester I	6+3=9
Semester II	6+3=9
Semester III	5+6=11
Semester IV	2+5=7
Semester V	3+8=11
Semester VI	0+8=8
Total	22+33=55

M.Sc. (Horticulture)

Common Courses

HOR 611 BIOTECHNOLOGY OF HORTICULTURAL CROPS (2+1)

Objective

Understanding the principles of biotechnology, learning about the various developments in biotechnology and its potential applications.

Theory

Unit I

Harnessing bio-technology in horticultural crops, influence of plant materials, physical, chemical factors and growth regulators on growth and development of plant cell, tissue and organ cultures.

Unit II

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

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.

Unit IV

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

Unit V

Cryopreservation, genetic engineering in horticulture crops, use of molecular markers, *in vitro* selection for biotic and abiotic stress, achievements of biotechnology in horticultural crops.

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 horticultural crops.
2. Influence of plant materials and physical factors on growth and development of plant cell tissues and organs.
3. Role of chemical factors on growth and development of plant cell tissues and organs.
4. Callus cultures, isolation, initiation, development and multiplication.
5. Meristem culture for disease elimination.
6. Production of haploids and dihaploids through anther, pollen and ovule culture.
7. Embryo culture techniques, wide hybridization and embryo rescue.
8. Endosperm culture and its applications.
9. Rapid *in vitro* clonal propagation through direct organogenesis.
10. Somatic embryogenesis and regeneration of plantlets.
11. Hardening and establishment of tissue cultured plantlets in the primary, secondary nursery and field.

12. Somaclonal variations and its applications.
13. Types of cell cultures.
14. Development of suspension cultures, types of cultures and influence of different factors.
15. *In vitro* production of secondary metabolites
16. Role of bioreactors in production of secondary metabolites
17. **Mid-Semester Examination**
18. Protoplast culture and regeneration and protoplast fusion.
19. Construction of somatic hybrids and cybrids.
20. Techniques of *in vitro* pollination and fertilization.
21. *In vitro* mutation and its applications
22. Synthetic seed production techniques
23. Applications and limitations of synthetic seeds.
24. *In vitro* conservation and cryopreservation techniques.
25. Plant DNA isolation technique.
26. PCR amplification, principles, methods and applications.
27. Gel electrophoresis.
28. Genetic Engineering and transgenics.
29. Vectors and methods of transformation.
30. Indirect methods, Agrobacterium mediated gene transfer.
31. Gene transfer, microinjection, PEG and Viral mediated transfection
32. Selection of the transformed plants.
33. Transgenic plants in horticultural crops.
34. Achievements of bio-technology in horticultural crops.

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.

Reference books

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HOR 612 GROWTH AND DEVELOPMENT OF HORTICULTURAL CROPS (2+1)

Objective

Understanding of growth and development of horticultural crops which have implications in their management.

Theory

Unit I

Growth and development, definitions, components, photosynthetic productivity, leaf area index (LAI), optimum LAI in horticultural crops, canopy development, different stages of growth, growth curves, growth analysis in horticultural crops.

Unit II

Plant bio regulators, auxins, gibberellins, cytokinins, ethylene, inhibitors and retardants, basic functions, biosynthesis, role in crop growth and development, propagation, flowering, fruit setting, fruit thinning, fruit development, fruit drop and fruit ripening.

Unit III

Flowering, factors affecting flowering, physiology of flowering, photoperiodism, long day, short day and day natural plants, vernalisation and its applications in horticulture.

Unit IV

Pruning and training, physiological basis of training and pruning, source and sink relationship, translocation of assimilates, physiology of seed development and maturation, seed dormancy and bud dormancy, causes and methods of overcoming dormancy in horticultural crops.

Unit V

Physiology of fruit growth and development, fruit setting, factors affecting fruit set and development, physiology of ripening of fruits, climacteric and non-climacteric fruits, molecular and genetic approaches, senescence, mechanism, bio-chemical and physiological changes, longevity of leaves in perennial and annual crops, stress physiology, heat, cold, moisture and salinity stresses, post harvest physiology of horticultural crops.

Practical

Understanding dormancy mechanisms in seeds, tubers and bulbs and stratification of seeds, tubers and bulbs, visit to arid, subtropical and temperate horticultural zones to identify growth and development patterns, techniques of growth analysis, evaluation of photosynthetic efficiency under different environments, study of growth regulator functions, hormone assays, understanding ripening phenomenon in fruits and vegetables, study of impact of physical manipulations on growth and development, study of chemical manipulations on growth and development, understanding stress impact on growth and development.

Lecture schedule

1. Growth and development – definition and parameters of growth and development.
2. Study of principles involved in growth dynamics.
3. Growth and development of annual horticultural crops.
4. Growth and development of perennial and semi – perennial horticultural crops.
5. Effect of light, photosynthesis, photoperiodism and vernalisation on horticultural crops.
6. Effect of temperature, heat units and thermoperiodism on annual horticultural crops.
7. Effect of temperature, heat units and thermoperiodism on perennial horticultural crops.
8. Assimilate partitioning during growth and development.
9. Role of water and mineral nutrition on growth and development of horticultural crops.
10. Biosynthesis of auxins and their role.
11. Gibberellin synthesis and their role.
12. Cytokinin synthesis and their role.
13. Abscisic acid synthesis and their role.
14. Ethylene synthesis and their role.
15. Brassinosteroid synthesis and their role.
16. Role of growth inhibitors in horticultural crops.
17. **Mid semester examination.**
18. Various types and basis of dormancy and methods of breaking dormancy.
19. Physiological and biochemical process of bud breaking.
20. Physiological and biochemical changes which occurs in the inter phase of vegetative to reproductive stages
21. Physiological and biochemical basis of flowering, pollination and fertilization.
22. Physiological changes occurring at fruit set - causes and remedies of fruit drop.
23. Various stages of fruit growth and physiological and bio-chemical basis of ripening.
24. Basis of seed development.
25. Causes and various types of stress.
26. Effect of stress on growth and development process.
27. Manipulation of growth and development, role of canopy management and its importance in horticultural crops.
28. Types of training and its impact on perennial horticultural crops.
29. Principles, causes, types and importance of pruning.
30. Types of chemical manipulation in horticultural crops.
31. Molecular and genetic approaches in plant growth and development.
32. Senescence, mechanism, bio chemical and physiological changes.
33. Stress physiology, heat, cold, moisture and salinity stresses.
34. Post harvest physiology of horticultural crops.

Practical schedule

1. Study of different types of dormancy and methods of breaking dormancy in seeds.
2. Vernalisation and stratification of seeds.
3. Dormancy and methods to overcome dormancy in tubers and bulbs.
4. Study of growth and development pattern of arid horticultural crops.
5. Estimation of leaf area index.
6. Visit to sub – tropical and temperate zones to study the growth and development pattern of horticultural crops.
7. Various techniques to measure and analyse the growth.
8. Estimation of number of buds to be pruned in grapes for maximum production.
9. Evaluation of photosynthetic efficiency under different environmental conditions.
10. Study of functions of growth regulators.
11. Estimation of hormonal assay on annual and perennial horticultural crops.
12. Measurement of physiological and biochemical processes which occur during ripening of fruits.
13. Measurement of physiological and biochemical processes which occur during senescence of vegetables.
14. Study of chemical manipulation on growth and development.
15. Study of factors involving stress
16. Standardization of ethylene with effect to ripening of fruits.
17. Experiment on post harvest loss in horticultural crops.

Reference Books

1. Buchanan.B. W. Gruissam and R. Jones. 2002. Biochemistry and Molecular Biology of Plants. John Wiley & Sons
2. Epstein, E. 1972. Mineral Nutrition of Plants: Principles and Perspectives. Wiley, New York.
3. Fosket, Donald E. 1994. Plant Growth and Development: A Molecular Approach, Academic Press, San Diego, CA.
4. Jain, V.K., 1997, Fundamentals of Plant Physiology, S. Chand and Company Ltd., New Delhi.
5. Kitchen, H.B., 1982. Soil and Crop-Diagnostic Techniques, International Book and Periodical Supply Service, New Delhi.
6. Krishnamoorthy, H.N. 1981. Plant Growth Substances. Tata McGraw Hill Publishing Co. Ltd., New York
7. Leopold, A.C. and P.E. Kriedermann, 1985. Plant Growth and Development. 3rd Ed. MC. Graw – Hill, New York.
8. Roberts, J., S. Downs and P. Parker. 2002. Plant Growth Development in Plants (Edited by I. Ridge) pp221-274. Oxford University Press, UK.
9. Salisbury, Frank B. and Ross. Cleon W. 1992. Plant Physiology, 4th ed. Wadsworth Publishing Co., Belmont, CA.

HOR 613 METHODS OF BREEDING OF HORTICULTURAL CROPS (2+1)

Objective

To understand the principles, requirements and methods of breeding of horticultural crops.

Theory

Unit I

Origin of species, centres of diversity, bio diversity conservation, agencies, gene bank, collection, conservation and utilization of genetic resources, field gene bank, cryopreservation, pollen preservation.

Unit II

Objectives and scope of plant breeding in horticultural crops, breeding systems, methods in horticultural crops, modes of reproduction, mechanisms of pollination control, sterility and incompatibility systems.

Unit III

Objectives and scope of breeding in annual horticultural crops, approaches for crop improvement, introduction, selection, hybridization, pedigree breeding, bulk, single seed descent method, mass selection, recurrent and reciprocal recurrent selection, back cross breeding, heterosis breeding, development of F₁ hybrids, synthetics, composites, mutation breeding, ploidy breeding, breeding for quality traits, resistance breeding for biotic and abiotic stress.

Unit IV

Objectives, scope and problems in breeding of perennial horticultural crops, modes of reproduction, approaches for crop improvement, introduction, selection, hybridization, mutation breeding, ploidy breeding, breeding for quality traits, resistance breeding for biotic and abiotic stresses.

Unit V

Molecular tools for breeding, molecular markers, protein based and PCR based detection for genetic confirmation, *in-vitro* mutation breeding, genetic transformation methods, vector transformation and particle bombardment, RNA i technology, emerging concepts and applications.

Practical

Study of breeding systems in crops, study of variation, floral biology, hybridization techniques, estimation of heterosis, PCV, GCV, heritability, D² analysis, genetic fidelity testing, molecular characterization, protocols for *in-vitro* mutation breeding and polyploidy breeding, visit to regional and national research institutes taking up breeding of horticultural crops.

Lecture schedule

1. Origin of species, centres of diversity.
2. Bio diversity conservation, agencies, gene bank.
3. Collection, conservation and utilization of genetic resources.
4. Field gene bank, cryopreservation, pollen preservation.

5. Objectives and scope of plant breeding in horticultural crops.
6. Breeding systems, methods of reproduction in horticultural crops.
7. Modes of reproduction, mechanisms of pollination control, sterility and incompatibility systems.
8. Crop improvement methods in annual horticultural crops- introduction and selection.
9. Crop improvement methods in annual horticultural crops- hybridization.
10. Crop improvement methods in annual horticultural crops- pedigree breeding.
11. Crop improvement methods in annual horticultural crops- bulk and single seed descent methods.
12. Crop improvement methods in annual horticultural crops- mass selection, recurrent and reciprocal recurrent selection.
13. Crop improvement methods in annual horticultural crops- back cross breeding.
14. Crop improvement methods in annual horticultural crops - heterosis breeding, exploitation of hybrid vigour.
15. Development of F₁ hybrids – methods and procedures in various annual horticultural crops.
16. Synthetics and composites.
17. **Mid-Semester Examination**
18. Mutation breeding in annual horticultural crops.
19. Ploidy breeding in annual horticultural crops.
20. Objectives, scope and problems in breeding of perennial horticultural crops.
21. Perennial horticultural crop improvement through introduction and clonal selection.
22. Perennial horticultural crop improvement through hybridization.
23. Perennial horticultural crop improvement through mutation breeding.
24. Perennial horticultural crop improvement through ploidy breeding.
25. Breeding for quality traits – improvement of pigment concentration in horticultural crops.
26. Breeding for quality traits – improvement of shelf life.
27. Concepts of breeding for resistance to biotic stresses.
28. Methods of breeding for resistance to biotic stresses in horticultural crops.
29. Concepts of breeding for resistance to abiotic stresses in horticultural crops.
30. Methods of breeding for resistance to abiotic stresses in horticultural crops.
31. Somatic hybridization.
32. Molecular markers, genetic fidelity confirmation and marker assisted selection.
33. Genetic transformation methods.
34. Emerging concepts and applications in horticultural crop improvement.

Practical schedule

1. Study of floral biology of selected horticultural crops.
2. Study of pollen production and fertility
3. Practices in hybridization of selected perennial and annual horticultural crops.
4. Crossing programmes – diallel.
5. Characterization and documentation of germplasm.
6. Estimating genetic diversity- interpreting cluster analysis and dendrogram.
7. Selection procedures in annual horticultural crops
8. Handling segregating population
9. Clonal evaluation and plus tree identification.
10. Estimation of PCV, GCV and heritability
11. Practices in F₁ seed production
12. Estimation of heterosis

13. Estimation of stability parameters
14. Practices in *in vivo* mutation breeding
15. Varietal description of annual and perennial horticultural crops.
16. Practices in polyploidy breeding of annual horticultural crops.
17. Practices in polyploidy breeding of perennial horticultural crops.

Reference Books

1. Adrian Slater, Nigel Scott, and Mark R. Fowler.2008. Plant Biotechnology: The Genetic Manipulation of Plants, Oxford ,Great Britain
2. Allard,R.W.1999.Principles of Plant Breeding, Wiley & Sons, NY
3. Blum, A.1998. Plant Breeding for Stress. Scientific Book Suppliers, NewDelhi.
4. Cock Shull, K.E., D. Gray, G.B. Seymour and B.Thomas.1978. Genetic and Environmental Manipulation of Horticultural Crops.CAB Publishing, U.K.
5. Hari Har Ram.2005Vegetable Breeding-Principles and Practices. Kalyani Publishers. New Delhi.
6. Jainck, J. and J.N.Moore.1975.Advances in Fruit Breeding, Purdue University Press, India.
7. Jainick, J.1996. Fruit Breeding. Jagmander Book Agency, New Delhi.
8. Kalloo.G.1980.Vegetable Breeding. Vol. I, II, and III. Panima Education Book Agency, New Delhi.
9. Kumar, N .2006. Breeding of Horticultural Crops : Principles and Practices : New India
10. Neal C. Stoskopf, Dwight T. Tomes and B.R. Christie, 2006. Plant Breeding: Theory and Practice. Scientific Publishers, Jodhpur , India

HOR 614- RESEARCH ETHICS AND METHODOLOGY (0+1)** (Non Credit Compulsory Subjects)

Objective

To enlighten the students about the agricultural research systems at national and international levels, Research ethics, and Research methodologies adopted to carry out agricultural research. Further to train the students on preparation of research projects, implementation documentation and presentation of results before research community.

Research Ethics

Global agricultural research system - need, scope, opportunities, role in food security, poverty reduction and environmental protection; National Agricultural Research Systems (NARS) and Regional Agricultural Research Institutions; Consultative Group on International Agricultural Research (CGIAR): International Agricultural Research Centres (IARC)-International fellowships for scientific mobility. Research ethics: research integrity, research safety in laboratories, welfare of animals used in research, computer ethics, standards and problems in research ethics-Good Laboratory Practices – Plagiarism and Copy right rules.

Research Methodology

Selection of research project on current horticultural problems, preparation of research project proposals, formulation of research programmes for independent research, presentation and defending of the research proposal before a committee / audience, seminar preparation and presentation, role of audio- visual aids, library use, indexing and documentation, literature collection, use of e-journals, internet and other information sources, methodology for conduct of laboratory, green house, pot culture and field experiments, recording, compiling and interpretation of data, arranging and tabulating the data and computerization working with statistical packages (software's) for analysis of data of

horticultural experiments, interpretation of data , writing of results, thesis preparation, presenting and defending, preparation of research and popular articles and extension literature, writing of research report and project completion report, evaluation of schemes / projects / articles.

Practical schedule

- 1) Global agricultural research system: need, scope, opportunities, role in food security, poverty reduction and environmental protection
- 2) National Agricultural Research Systems (NARS) and Regional Agricultural Research Institutions; Consultative Group on International Agricultural Research (CGIAR)
- 3) International Agricultural Research Centres (IARC)-International fellowships for scientific mobility.
- 1) Research ethics: research integrity, research safety in laboratories and Welfare of animals used in research
- 2) Computer ethics, Standards and problems in research ethics
- 3) Good Laboratory Practices – Plagiarism and Copy right rules
- 4) Selection of viable project and preparation of research project proposals
- 5) Literature collection -Library use, indexing, documentation, e-journals and internet information sources
- 6) **Mid -Semester**
- 7) Review of literature and formulation of research programmes
- 8) Methodology for conduct of laboratory, green house, pot culture and field experiments.
- 9) Recording, compiling and interpretation of data, study of laboratory analytical procedures for horticultural experiments
- 10) Arranging and tabulating the data and computerization, working with statistical packages (softwares) for analysis of data of experiments and interpretation.
- 11) Writing of results, thesis preparation, presenting and defending
- 12) Presentation and defending the research project proposal before a committee/ audience
- 13) Seminar preparation on allotted topics and presentation
- 14) Writing of Research, Review and Popular articles.

Reference Books

1. Best, J.W. and J.V. Kahn. 1996. Research in Education. Prentice Hall India Pvt. Ltd. New York.
2. Federer, W.T. 1993. Experimental Design - Theory and Application. Oxford and IBH Publishing Co. (P) Ltd., New Delhi.
3. Kottari, C.R. 1997. Research Methodology , Wishawa Prakasam, New Delhi
4. Linidsay, D. 1991. A Guide to Scientific Writing. Manual for Students and Research Workers. Longman Cheshire, Melbourne.
5. Mason, J. Emanuel and W.J. Bramble. 1978. Understanding and Conducting Research- Applications in Education and Behavioural Sciences Mc. Graw Hill Book Co., New York.

HOR 711 PROTECTED CULTIVATION AND PRECISION HORTICULTURE (1+1)

Objective

This course aims to impart knowledge on the role of climatic and edaphic factors affecting plant growth and development and to study the various modes of protected cultivation, its scope and constraints. It highlights various measures to control light, temperature, relative humidity and CO₂ and recent advances in control of substrate factors like pH, EC and soil

microbes. It elaborates the production system so as to acquire knowledge on the cost of establishment and procedures for commencing hi-tech projects.

Theory

Unit-I

Profiles of crop production system, protected cultivation, overview, importance, scope and constraints under Indian conditions, modes of protected cultivation, planning of green house, styles, design, green house covering materials.

Unit-II

Green house, growing media, pre-plant treatment of media, green house benches, green house environment control systems, temperature control, cooling system, heating system, light, photoperiod manipulation.

Unit-III

Green house irrigation, types, planning, designing, installation, operation and maintenance, fertilizer sources – fertigation, water soluble fertilizers – application method – fertilizer programmes for vegetables and flowers.

Unit-IV

Plug production, modular containers, media, automatic mixers, fillers, mechanical seeder, seed pelleting, priming, root trainers, insects and disease control system, fogging system, smoke generator, thermal fogging for insect and disease control.

Unit-V

Precision horticulture, principles and concepts, enabling technologies of precision farming- GPS, GIS, Remote sensing, sensors, variability management in precision farming, mapping- variable rate technology, precision equipments- computers and robotics in precision farming

Practical

Modes of protected cultivation, parts of green house and structural components, glazing/cladding materials, media and sterilization, beds and benches construction and lay out - environment control, ventilation, cooling, heating, lighting, irrigation, fertigation and IPM, special horticultural practices, economics of hi-tech production systems, visit to hi-tech units , GPS, GIS, remote sensing facility.

Lecture schedule

1. Present status of green house cultivation in India, constraints and scope
2. Modes of protected cultivation
3. Site selection, structural designs , styles, single and multispans
4. Green house roofing materials
5. Green house media, natural and synthetic and sterilization
6. Green house , beds and benches construction and space use efficiency
7. Temperature control, heating, cooling , lighting
8. Cooling methods, ventilations, evaporative cooling , air conditioning
9. **Mid Semester Examination.**
10. Types of irrigation in green house , purpose and advantage
11. Fertigation, advantages, water soluble fertilizer
12. Fertilizer requirement for various green house crops.
13. Bedding industry, plug production , modular containers
14. Training and pruning methods of green house flower and vegetables crops.
15. Precision horticulture, principles and concepts , GPS, GIS, Remote sensing- sensors
16. Variability management in precision farming, mapping- variable rate technology

17. Precision equipments, computers and robotics in precision farming

Practical Schedule

1. Study of various modes of protected cultivation.
2. Components of poly house and structural designs and styles.
3. Estimating the cost of low cost green house of IARI model.
4. Designing covering material.
5. Designing of ventilation – passive and active.
6. Designing of cooling systems.
7. Establishing evaporative cooling system.
8. Designing an irrigation system.
9. Estimation of light requirement for various purposes.
10. Working out the space use efficiency of beds and benches.
11. Study of fertigation methods.
12. Fertilizer calculation.
13. Economics of green house cultivation of rose.
14. Economics of green house cultivation of vegetables.
15. Visit to export oriented floriculture units at Hosur.
16. Visit to precision farming unit.
17. Visit to GPS, GIS and remote sensing facility.

Reference books

1. James, Lr. Boodley. 1981. The Commercial Green House. Ball Publishing, USA.
2. Paul, V. Nelson. 1991. Green House Operation and Management. Ball Publishing, USA.
3. Prasad, S. and V. Kumar. 1999. Green House Management for Horticultural Crops. Agrobios India, Jodhpur.
4. Robert, A. Aldrich and John W. Bartok, Jr. 1990. Green House Engineering. Ball publishing, USA.
5. Reddy, S. Janakiram, B., Balaji T. Kulkarni, S. and Misra R.L. 2007. Hightech Floriculture. Indian Society of Ornamental Horticulture, New Delhi.
6. Aldrich R.A and Bartok J.W. 1994. Green House Engineering. NRAES, Riley, Robb Hall, Cornell University, Ithaca, New York.
7. Prasad, S. and Kumar, U. 2005. Greenhouse Management for Horticultural Crops. 2nd Ed. Agrobios.
8. Tiwari, G.N. 2003. Green House Technology for Controlled Environment. Narosa publishing house.
9. Pranab Hazra, A. Chattopadyay, K.Karmakar and S.Dutta. 2011. Modern Technology in vegetable production. New India publishing agency.
10. Sharma and Premjit. 2007. Precision Farming. Eastern Book Corporation.

HOR 712 URBAN AND ENVIRONMENTAL HORTICULTURE (1+1)

Objective

To update the knowledge on the recent advances in environmental issues and Urban Horticulture associated with ecosystem.

Unit I

Ecological factors in horticultural production, controlling system inputs and outputs, climate change, global warming, acid rain, ozone layer depletion, green house gases, elevated CO₂ and its impact on productivity of horticultural systems, loss of biodiversity, carbon credit carbon trading and carbon sequestration .

Unit II

Threats to urban landscape resources; urban environmental issues such as solid waste management, air quality, conservation of water resources and vegetation cover- environmental pollution, classification, sources of air, water and land pollution; effects of air water and land pollutants on plants, status of air, water and land pollution in India, noise and radiation pollution, definition and types, water pollution, control technologies, physical and chemical methods.

Unit III

Physical and chemical characteristics of agricultural solid waste and its composition, solid waste treatment methods, Physical, open dumping, sanitary land filling, ocean dumping and incineration; chemical methods, pyrolysis; biological methods, composting of solid waste (aerobic and anaerobic) and vermicomposting methods.

Unit IV

Urban land use planning and modification of native vegetation for pollution issues, global trends in urban horticulture, container gardening, vertical gardens, herbal garden, roof gardening, kitchen garden, basics, techniques and layout, hydroponics, house plants care and maintenance, xeriscaping – balling and burlaping .

Unit V

Definitions and terms used in social and therapeutic horticulture practice, methods and approaches used in therapeutic horticulture, planning, design and construction issues in the design of the therapeutic landscapes, tools, equipment and materials, aroma therapy definition and applications, aroma garden, vegetable carving, tools and basics.

PRACTICAL

Eco-system, carbon use efficiency, noise pollution determination, estimation of respirable and non - respirable dust in the air by using portable dust sampler, total dissolved solids (tds), social service organizations involved in creating environment awareness, environmental education centers, visit to a local polluted site, observations and remedial measures, industrial sewage disposal unit, composting techniques – vermi culture, mine spoil and pond ash reclamation through horticultural crops, urban planning and planting avenues, schools, villages, beautifying railway stations, colonies, planting material for play grounds, description and design of terrace garden, container gardening, water proofing techniques, horticultural crafts for social welfare, bonsai culture, bouquet making, flower arrangements, vegetable carving, garden tools and implements.

Lecture schedule

1. Ecological factors in horticultural production, controlling system inputs and outputs,
2. Climate change, global warming, acid rain, ozone layer depletion, green house gases, elevated CO₂ and its impact on productivity of horticultural systems, loss of biodiversity.
3. Carbon credit, carbon trading and carbon sequestration
4. Threats to urban landscape resources; urban environmental issues such as solid waste management and air quality conservation of water resources and vegetation cover

5. Environmental pollution, classification, sources of air, water and land pollution; effects of air water and land pollutants on plants, status of air, water and land pollution in India
6. Noise and radiation pollution, definition and types, water pollution, control technologies, physical and chemical methods
7. Physical and chemical characteristics of agricultural solid waste and its composition.
8. Solid waste treatment methods, Physical, open dumping, sanitary land filling, ocean dumping and incineration
9. Mid-Semester
10. Chemical methods, pyrolysis; biological methods, composting of solid waste (aerobic and anaerobic) and Vermiculture and vermicomposting methods.
11. Urban land use planning and modification of native vegetation for pollution issues
12. Global trends in urban horticulture, container gardening, vertical gardens, herbal garden, roof gardening, kitchen garden, basics, techniques and layout.
13. Hydroponics, house plants care and maintenance, xeriscaping.
14. Balling and burlaping
15. Definitions and terms used in social and therapeutic horticulture practice, community gardening, methods and approaches used in therapeutic horticulture, planning.
16. Design and construction issues in the design of the therapeutic landscapes, tools, equipment and materials and aroma therapy definition and applications
17. Aroma garden, vegetable carving, tools and basics

Practical schedule

1. Estimation of carbon use efficiency
2. Noise pollution determination, estimation of respirable and non - respirable dust in the air by using portable dust sampler.
3. Estimation of Total dissolved solids (tds)
4. Effluent treatment methods in agro processing units
5. Solid waste disposal methods
6. Vermiculture, mine spoil and pond ash reclamation through horticultural crops
7. Urban planning and planting avenues, schools, villages
8. Beautifying railway stations, colonies
9. Environmental legislations and agencies
10. Description and design of terrace garden, container gardening
11. Water proofing techniques – Terrace gardens
12. Horticultural crafts for social welfare
13. Bonsai culture
14. Bouquet making
15. Flower arrangements
16. Vegetable carving
17. Social service organizations involved in creating environment awareness environmental education centers, visit to a local polluted site.

Reference books

1. Hank Bruce and Tomi Jill Folk, 2003. Garden Projects for the Classroom and Special Learning Programs. Petals and Pages.
2. Hank Bruce, 2000. Gardening Projects for Horticultural Therapy Programs. Petals and Pages
3. Sharon P. Simson, and Martha C. Straus, 1998. Horticulture as Therapy: principles and Practices, HTM, Haworth Press.

4. Maureen A. Phillips & Sheila B. Taft, 2006. Indoor Nature & Plant Craft Activities
www.phillipstaft.com;
5. Thakur, V., 2012, A Text Book of Environmental Science, Scientific publishers, Jothpur.

HOR 721 POSTHARVEST TECHNOLOGY OF HORTICULTURAL CROPS (2+1)

Objective

To understand the basics and principles of post harvest technology and recent innovations in packaging, storage and transport of horticultural crops.

Theory

Unit I

Post harvest technology scenario in horticultural crops, harvest indices, harvesting methods in horticultural crops, 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 losses.

Unit II

Fruit ripening , physiology and bio chemistry 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 *viz.*, ventilated, refrigerated, MAS, CAS, physical injuries and disorders during storage.

Unit IV

Principles and methods of preservation, minimal processing of fruits and vegetables, Pre treatment, blanching, canning and irradiation, value addition in horticultural crops, fruit juices and beverages , pickles, jam, jellies, marmalades, candies, glazed, crystallized fruits, dried and dehydrated products, nutritionally enriched / fortified products- encapsulated fruit flavors.

Unit V

Packaging technologies, packaging materials and transport, by products from processing and its management, quality control and regulation of fresh/ processed products.

Practical

Experiment 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 horticultural 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 vegetables, harvesting practices for specific market requirements
4. Harvest indices, physiological and horticultural maturity of commercial flowers, harvesting practices for specific market requirements
5. Harvest indices, physiological and horticultural maturity of major spices and medicinal plants, harvesting practices for specific market requirements.
6. Influence of pre- harvest practices on post harvest of fruits.
7. Influence of pre- harvest practices on post harvest of vegetables.
8. Influence of pre- harvest practices on post harvest of flowers.
9. Influence of pre- harvest practices on post harvest of spices and plantation crops.

10. Influence of pre- harvest practices on post harvest of medicinal plants.
11. Major factors leading to post harvest losses
12. Fruit ripening – climateric and non- climateric ripening
13. Bio chemical and physiological changes during ripening
14. Respiration, transpiration, ethylene evolution and ethylene management of fresh produces
15. Pre- cooling treatments prior to transport, chlorination, waxing, chemicals, bio control agents and natural plant products,
16. Storage methods for fresh produces (Ventilated, Cold storage)
17. **Mid Semester Examination**
18. Modified atmospheric and controlled atmospheric storage (MAS, CAS)
19. Disorders and injuries during storage.
20. Packaging technology and packaging materials – characteristics and selection.
21. Refrigerated transport system for fresh produce.
22. Minimal processing of fruits and vegetables – merits and demerits.
23. Cold chain in maintenance and supply chain management.
24. Principles and methods of preservation and processing
25. Pre- treatments – blanching and canning.
26. Value added products from horticultural crops – fruits juices and beverages.
27. Pickles.
28. Jam, jellies, marmalades.
29. Dried and dehydrated products
30. Nutritionally enriched or fortified products, encapsulated fruit flavours.
31. Packaging technology for processed products.
32. General principles and quality standards and control.
33. Food safety standards
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. Exercise on storage of vegetables.
8. Preparation of squash and jam.
9. Preparation of jelly.
10. Preparation of sauce and ketchup.
11. Preparation of brine and syrup for preservation.
12. Preparation of pickle.
13. Practices of lye peeling and scalding.
14. Experiment on dehydration of fruits.
15. Experiment on dehydration of vegetables.
16. Visit to commercial processing industry.
17. Project preparation to establish processing industry.

Reference books

1. Ashwani, K. Goel. 2007. Post Harvest Management and Value Addition. Daya Publishing House. New Delhi.
2. Cruesss, W.V. 2000. Commercial Fruit and Vegetable Products. Agrobios (India), Jodhpur
3. Jacob John. 2008. A Hand Book on Post Harvest Management of Fruits and Vegetables. Daya Publishing House. New Delhi.
4. Loasecke, H W.V. 2001. Drying and Dehydration of Foods. Agrobios (India), Jodhpur
5. Manorajan kalia. 2006. Post Harvest Technology of Vegetables. Agrotech Publishing Academy. Udaipur.
6. Pandey, P.H.2002. Postharvest Technologies of Fruits and Vegetables. Principles and practices. Saroj Publishers and Distributors, Allahabad.
7. Saraswathy,S. T.L. Preethi, S. Balasubramnyan, S. Suresh, N. Revathy, S. Natarajan. 2008. Post Harvest Management of Vegetable Crops. Agrobios (India) Jodhpur.
8. Sumanbhatti and Uma Varma. 1995. Fruit and Vegetable Processing. CBS Publishers and Distributors, New Delhi.
9. Thompson, A. K. 1996. Post Harvest Technology of Fruits and Vegetables. Blackwell Science, Inc. Cambridge.
10. Verma, L.R and V.K. Joshi 2000. Post Harvest Technology of Fruits and Vegetables (Vol I & II). Indus Publishing Company, New Delhi.

M.Sc. (Hort.) Fruit Science
Major courses

FSC 611 TROPICAL AND DRY LAND FRUIT PRODUCTION (2+1)

Objective

To impart knowledge on the importance, latest production aspects, scientific management practices, problems associated, postharvest management and marketing potential of tropical and dry land fruit crops grown 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, honeybees in cross pollination, physiological disorders, causes and remedies, organic production technologies, quality improvement by management practices; maturity indices, harvesting, grading, packing, storage and ripening techniques; industrial and export potential, Agri. Export Zones (AEZ), industrial supports and research advancements made in the following fruit crops at concerned regional research centers.

Unit I Mango and banana

Unit II Citrus, sapota and guava

Unit III Papaya, jackfruit and pomegranate

Unit IV Aonla, ber, jamun and annona

Unit V Wood apple, bael, karonda, manila tamarind and phalsa

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. Tropical and dry land fruit crops, scope and current status on area, production and export 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; 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 Beal
- 31. Karonda
- 32. Manila tamarind
- 33. Phalsa
- 34. Processing industries based on tropical and arid zone fruit production

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

Reference books

1. Bose TK, Mitra SK and Rathore DS. (Eds.) 1988. Temperate Fruits-Horticulture. Allied Publ.
2. Bose TK, Mitra SK and Sanyal D. 2001. (Eds.) Fruits – Tropical and Subtropical. Naya Udyog.
3. Chanda KL and Pareek OP. 1996. (Eds.) Advances in Horticulture. Vols II to IV. Malhotra Publ. House.
4. Nakasone HY and Paul RE. 1998. Tropical Fruits. CABI. UK
5. Peter KV. 2008. Basics of Horticulture. New India Publ. Agency.

6. Pradeepkumar T, Suma B, Jyothibhaskar and Sathesan KN. 2008. Management of Horticultural Crops. Parts I, II. New India Publ. Agency
7. Radha T and Mathew L. 2007. Fruit Crops. New India Publ. Agency
8. Singh HP, Negi JP and Samul JC. (Eds.) 2002. Approaches for Sustainable Development of Horticulture. National Horticultural Board.
9. Singh HP, Singh G, Samuel JC and Pathak RK. (Eds.) 2003. Precision Farming in Horticulture. NCPAH, DAC/PFDC, CISH, Lucknow.

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

Objective

To impart knowledge on the importance, latest production aspects, scientific management practices, problems associated, postharvest management and marketing potential of subtropical and temperate fruits grown 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, local and export market potential, AEZs and industrial support, research advances made in the following fruit crops:

Unit I Hill banana, grapes, mandarin and pineapple

Unit II Mangosteen, durian, passion fruit, kokam, fig and avocado

Unit III Persimmon, loquat, litchi, rambutan, carambola and bilimbi

Unit IV Apple, pear, plums, peach, strawberry, apricot, cherries, kiwi fruit

Unit V Walnut, almond, pistachio, pecan and hazelnut.

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 and area and production of subtropical and temperate climate in Tamilnadu and India
2. 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 local and export market potential for the following subtropical and temperate fruit crops:
3. Hill banana
- 4-5. 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 based on subtropical and temperate fruit production

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 systems for southern (Tamilnadu) temperate areas
13. Nutrition management for subtropical fruits
14. Nutrition management for 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

Reference Books

1. Bose TK, Mitra SK and Rathore DS. (Eds.). 1988. Temperate Fruits -Horticulture. Allied Publ.
2. Bose TK, Mitra SK and Sanyal D. 2001. (Eds.). Fruits -Tropical and Subtropical. Naya Udyog.
3. Chadha KL and Pareek OP. 1996. (Eds.). Advances in Horticulture. Vols. III-V. Malhotra Publ. House.
4. Nakasone HY and Paul RE. 1998. Tropical Fruits. CABI.
5. Peter KV. 2008. (Ed.). Basics of Horticulture. New India Publ. Agency.
6. Pradeepkumar T, Suma B, Jyothibhaskar and Satheesan KN. 2008. Management of Horticultural Crops. Parts I, II. New India Publ. Agency.
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8. Singh HP, Negi JP and Samuel JC. (Eds.). 2002. Approaches for Sustainable Development of Horticulture. National Horticultural Board.
9. Singh HP, Singh G, Samuel JC and Pathak RK. (Eds.). 2003. Precision Farming in Horticulture. NCPAH, DAC/PFDC, CISH, Lucknow.

FSC 623. BIODIVERSITY AND CONSERVATION OF FRUIT CROPS (2+1)

Objective

Understanding the principles of biodiversity, strategies in conservation and utilization of fruit crop biodiversity and about the under exploited fruits in India.

Theory

Unit I

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, introduction of germplasm, plant quarantine, role of national institutes in conservation, TBGRI, NBPGR.etc.,

Unit II

Intellectual property rights, regulatory horticulture, plant variety protection authority, detection of genetic fidelity and genetic constitution of germplasm and maintenance of core group using traditional knowledge for plant conservation.

Unit III

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

Unit IV

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

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

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,

detection of genetic constitution of germplasm, core sampling, germplasm characterization using molecular techniques.

Theory 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 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 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

Reference Books

1. Frankel O.H and Hawkes JG. 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 711 BREEDING OF FRUIT CROPS (2+1)

Objective

To impart comprehensive knowledge about different methods of breeding techniques employed, achievements made so far and problems encountered during 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

Mango, banana and papaya

Unit II

Guava, sapota and grapes

Unit III

Citrus, pine apple, jack fruit and avocado

Unit IV

Litchi, annona, ber and pomegranate

Unit V

Apple, pear, plum, peach, apricot and strawberry

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 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, pine apple, 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 subtropical research stations for studying the breeding programmes.

Reference books

1. Bose T.K., S.K. Mitra and D. Sanyal D. (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 1996. (Eds.). Advances in Horticulture. Vol. I. Malhotra Publ. House., New Delhi
3. Chadha KL and Shikhamany SD. 1999. The Grape: Improvement, Production and Post-Harvest Management. Malhotra Publ. House. New Delhi
4. Janick J and Moore JN. 1996. Fruit Breeding. Vols. I-III. John Wiley and Sons. USA
5. Nijjar GS. 1977. (Eds.). Fruit Breeding in India. Oxford & IBH.
6. Radha T & Mathew L. 2007. Fruit Crops. New India Publ. Agency.
7. Shukla, A.N., Shukla, A.N and Vashishtha, 2004. Fruit Breeding: Approaches and Achievements, International Book Distributing Co., Lucknow, UP.

M.Sc. (Hort.) Vegetable Science
Major courses
VSC 611 PRODUCTION TECHNOLOGY OF COOL SEASON
VEGETABLE CROPS (2 + 1)

Objective

To impart knowledge on production technology of cool season vegetables.

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

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

Unit- II

Root crops - carrot, radish, turnip and beetroot.

Unit- III

Potato and garlic.

Unit- IV

Peas and french beans.

Unit- V

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

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
- 25-26 French 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.

Reference books

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.
2. Decoteau, D.R. 2000. Vegetable Crops. Prentice Hall India Pvt. Ltd. New York.
3. Fageria, M.S., B. R. Choudhary and R. S. Dhaka. 2000. Vegetable Crops: Production Technology. Vol. II. Kalyani Publishers ,Ludhiana.
4. Gopalakrishnan, T.R. 2007. Vegetable Crops. New India Publishing Agency, New Delhi.
5. Hazra, P. and M.G. Som. 1999. Technology for Vegetable Production and Improvement. Naya Prakash Publications, Kolkatta
6. Rana, M.K. 2008. Scientific Cultivation of Vegetables. Kalyani Publishers, Ludhiana.
7. Rubatzky, V.E. and M. Yamaguchi. 1997. World Vegetables: Principles, Production and Singh, Nutritive Values. Chapman and Hall, New York.
8. D.K. 2007. Modern Vegetable Varieties and Production Technology. International Book Distributing Company, New Delhi.
9. Thamburaj. S. and N. Singh. 2004. Vegetables, Tuber Crops and Spices. ICAR.

10. Pranab Hazra, A. Chattopadhyay, K. Karmakar and S. Dutta. 2011. Modern Technology in Vegetable Production. New India Publishing agency, New Delhi.

VSC 621 PRODUCTION TECHNOLOGY OF WARM SEASON VEGETABLE CROPS (2 + 1)

Objective

To impart knowledge on the production technology of warm season vegetables.

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

Tomato, brinjal, chilli and sweet pepper

Unit II

Okra, dolichos beans, cowpea and cluster bean

Unit III

Cucurbitaceous vegetables

Unit IV

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

Unit V

Onion, moringa and amaranthus.

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. Precision production technology for tomato, brinjal, chillies.
34. Precision production technology for cucumber.

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.

Reference books

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.
2. Decoteau, D.R. 2000. Vegetable Crops. Prentice Hall India Pvt. Ltd. New York.
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4. Gopalakrishnan, T.R. 2007. Vegetable Crops. New India Publishing Agency, New Delhi.
5. Hazra, P. and M. G. Som. 1999. Technology for Vegetable Production and Improvement. Naya Prakash Publications, Kolkatta.
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8. D.K. 2007. Modern Vegetable Varieties and Production Technology. International Book Distributing Company, New Delhi.
9. Thamburaj. S. and N. Singh .2004. Vegetables, Tuber Crops and Spices. ICAR.
10. Pranab Hazra, A. Chattopadyay, K. Karmakar and S. Dutta. 2011. Modern Technology in Vegetable Production. New India Publishing Agency, New Delhi.
18. Sharma and Premjit. 2007. Precision farming. Eastern Book Corporation

VSC 623 SYSTEMATICS OF VEGETABLE CROPS (2+1)

Objective

To teach morphological, cytological and molecular taxonomy of vegetable crops.

Theory

Unit- I

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

Unit- II

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

Unit- III

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

Unit- IV

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

Unit- V

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

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.

Reference books

1. Pooja, 2004. Angiosperms, Discovery Publishing House, New Delhi.
2. Dutta, A.C. 1986. A Class Book of Botany. Oxford Univ. Press.
3. Pandey, B.P. 1999. Taxonomy of Angiosperms. S. Chand and Company.
4. Peter, K.V. and Pradeepkumar T. 2008. Genetics and Breeding of Vegetables. (Revised), ICAR.
5. Soule, J. 1985. Glossary for Horticultural Crops. John Wiley and Sons.
6. Srivastava, U. Mahajan R.K. Gangopadyay, K.K. Singh, M. and Dhillon, B.S. 2001. Minimal Descriptors of Agri-Horticultural Crops. Part-II: Vegetable Crops. NBPGR, New Delhi.
7. Vasistha, 1998. Taxonomy of Angiosperms. Kalyani Publishers Ludhiana.
8. Vincent, E.R. and Yamaguchi, M. 1997. World Vegetables. 2nd Ed. Chapman and Hall.

VSC 711 BREEDING OF VEGETABLE CROPS (2+1)

Objective

To impart knowledge on principles and practices of breeding of vegetable crops.

Theory

Origin, botany, taxonomy, cyto genetics, 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

Tomato, brinjal, chilli and sweet pepper.

Unit II

Cucurbitaceous vegetables.

Unit III

Cabbage, cauliflower, carrot, beet root and radish.

Unit IV

Onion, garlic, potato, tapioca and sweet potato.

Unit V

Okra, moringa, peas, beans and amaranthus.

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, D² 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 incompatibility, 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.

Reference books

1. Kalloo, G. 1994. Vegetable Breeding – Combined Edition – Panima Book Publishers, New Delhi.

2. Allard, R.W. 1960. Principles of Plant Breeding. John Wiley and sons, Inc., New York
3. Harihar Ram. 2001. Vegetable Breeding. Kalyani Publishers, Ludhiana.
4. Gupta, S.K. 2000. Plant Breeding. Theory and Techniques. Vedam Publishers, Solan.
5. Kumar, U. and M.J. Asija. 2004. Biodiversity: Principles and Conservation Agrobios, Jodhpur.
6. Rana, M.k. 2011. Breeding and Protection of Vegetables. New India Publishing Agency, New Delhi.

M.Sc. (Hort.) Floriculture and Landscape Gardening

Major Course

FLG 611 PRODUCTION TECHNOLOGY OF LOOSE FLOWERS (2+1)

Objective

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, 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:

Unit I

Jasmine and rose.

Unit II

Chrysanthemum, tuberose and marigold

Unit III

Crossandra, celosia, nerium and barleria.

Unit IV

Gomphrena, lotus, champaka, maruvu and marikolundu.

Unit V

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.

Practical

Description of species and varieties, propagation techniques, training and pruning techniques, practices in manuring, drip and fertigation, 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:

5-7. Jasmine

8 – 10. Rose

11 – 13. Chrysanthemum

14 – 16. Marigold

17. Mid Semester Examination

18 – 19. Tuberose

20. Crossandra

21. Celosia

22. Gomphrena

23. Nerium

24. Barleria

25. Lotus

26. Champaka

27. Maruvu and marikolundu

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, scented rose, 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. Training and pruning techniques in other loose flowers

8. Practices in layout of drip and fertigation systems

9. Practices in manuring and fertilizer scheduling in loose flowers

10. Practices in foliar nutrition and growth regulator application in loose flowers

11. Practices in special horticultural practices in loose flowers

12. Diagnosis of physiological and nutritional disorders and remedial measures in loose flowers

13. Maturity and harvesting standards and 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

Reference books

1. Bhattacharjee, S.K. 2006. Advances in Ornamental Horticulture. Vols. 1-VI. Pointer Publ.

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. Naya Udyog, Kolkata.

3. Bose, T.K., R.G. Maiti, R.S. Dhua and P. Das. 1999. Floriculture and Landscaping. Naya Prokash, Kolkata

4. Chadha, K.L. 1986. Ornamental Horticulture in India ICAR, Krishi Bhavan, New Delhi.

5. Chadha, K.L. and B. Chaudhury. 1992. Ornamental Horticulture in India ICAR Krishi Bhavan, 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.

FLG 621 PRODUCTION TECHNOLOGY OF CUT FLOWERS 2+1

Objective

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

Theory

Unit I

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 CO₂ 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:

Unit I

Rose and chrysanthemum

Unit II

Carnation, gerbera, anthurium.

Unit III

Orchids, gladiolus and dahlia

Unit IV

Lilium, bird of paradise, heliconia, china aster, alstroemeria, golden rod, gypsophilla, and lisianthus.

Unit V

Cut flower standards and grades, post-harvest handling, methods of delaying flower opening, pre-cooling, pulsing, packing, storage, transport, marketing, value addition in cut flowers.

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 remedial 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 CO₂ 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 -5. Rose.
- 6- 8. Chrysanthemum.
- 9-11. Carnation
- 12 -13. Gerbera
- 14 -16. Anthurium

17. Mid Semester Examination

- 18-20. Orchids.
21. Gladiolus
22. Dahlia.
23. Asiatic and oriental lily.
24. China aster
26. Bird of paradise.
27. Heliconia.
28. Alstroemeria.
30. Golden rod.
31. Gypsophila and Lisianthus.
32. Cut flower standards and grades
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.
17. Visit to hi-tech flower production units

Reference books

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
3. Chadha, K.L., and B. Chaudhury. 1992. Ornamental Horticulture in India ICAR.
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.

FLG 623 BREEDING OF FLOWER CROPS AND ORNAMENTAL PLANTS (2+1)

Objective

To impart comprehensive knowledge about the principles and practices of breeding of flower crops and ornamental plants.

Theory

Breeding objectives, breeding systems, specific breeding problems and achievements, patents, Plant Variety Protection Act and IPR issues of the following crops:

Unit I

Rose, jasmine, chrysanthemum and crossandra.

Unit II

Tuberose, carnation, marigold, gerbera and gladiolus.

Unit III

Orchids, anthurium, dahlia and nerium.

Unit IV

Flowering annuals – zinnia, cosmos, dianthus, snap dragon and pansy.

Unit V

Aster, petunia, liliiums, heliconia, bird of paradise, hibiscus, bougainvillea and other foliage.

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 flower crops and ornamental plants.

Lecture schedule

Breeding objectives, breeding systems, 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
27. Aster
28. Petuina
29. Liliun
30. Heliconia
31. Bird of paradise
32. Hibiscus
33. Bougainvillea and other foliages
34. Patents and Plant Variety Protection Act and IPR issues.

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.

Reference books

1. Arora, J.S. 2006. 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. Singh BD.1990. Plant Breeding. Kalyani, New Delhi
4. Bose, T.K. and L.P. Yadav. 1989. Commercial Flowers. Naya Prokash. Kolkatta
5. Chadha, K.L. and B. Choudhury.1992. Ornamental Horticulture in India. ICAR, New Delhi
6. Chadha, K.L. and S.K. Bhattacharjee. 1995. Advances in Horticulture. Vol. XII. Malhotra Publ. House, New Delhi

FLG 711 LANDSCAPING AND ORNAMENTAL GARDENING (2+1)

Objective

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

Theory

Unit I

Ornamental and landscape horticulture, definitions, prospects of 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 (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

Turfing, turf grasses, types, species, varieties and hybrids, selection of grasses for different locations, advances in turf establishment, turf management, irrigation, nutrition, special practices, turf mowing, aerating, rolling, top dressing, use of turf growth regulators (TGRs) and micro nutrients, establishment and maintenance of turfs for playgrounds, viz., golf, football, hockey, cricket and tennis.

Unit IV

Hardscape elements (non-living components), construction and maintenance, basic function and utility, establishment and maintenance of special types of garden, water garden, floating plants, oxy generating 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 V

Site analysis, client 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 designing, applications of CAD in landscape garden designing, creating legends for plant and non plant components, basics of photoshop software in garden designing.

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 garden
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. Turfing, turf grasses, types, species, varieties and hybrids, selection of grasses for different locations.

17. Mid Semester Examination.

18. Advances in turf establishment.
- 19-20. Turf management, irrigation, nutrition, special practices, turf mowing, aerating, rolling, top dressing, use of turf growth regulators (TGRs) and micro nutrients
- 21-22. Establishment and maintenance of turfs for playgrounds, viz., golf, football, hockey, cricket and tennis.
- 23-25. Hardscape elements (non-living components), construction and maintenance, basic function and utility.
- 26-27. Establishment and maintenance of special types of garden, water garden floating plants oxy generating plants, rock garden, bog garden vertical garden, roof garden, xeriscaping.
- 28-29. Bonsai, plants for bonsai, methods of bonsai culture, terrarium, flower arrangement and other horticultural crafts.
- 30-31. Site analysis, cliental preference, home, institute, industrial garden, public parks, amusements and theme parks.
32. Landscape drawing, fundamentals of manual drawing, scale symbols, layout ,plan view, elevation and perspective diagrams.
33. Computer software, manual and computer aided designing, applications of CAD in landscape garden designing.
34. Applications of CAD in landscape garden designing.

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.

Reference books

1. Beard, J.B.1973.Turfgrass: Science and Culture. Agro Botanica. Jodhpur.
2. Bose, T.K. and D.Mukherjee.1977.Gardening in India. Oxford and IBH Publication Co., Kolkata.
3. Brain Closton.1984. Landscape design with plants. Van Nostrad Reinhold company NewYork.
4. Chadha, K.L.1986. Ornamental Horticulture in India. ICAR. Krishi Bhavan, New Delhi.
5. Gopaldasamy Iyyankar.1970.Complete Gardening In Indian. Kalyan Printers, Bangalore.
6. Hari Krishna Pahiwal.2009.Ornamental gardening. National Book Trust, New Delhi.
7. Lancaster, P. 1991.Gardening in India, Oxford and IBH Publishing Co. (P) Ltd. Kolkatta.
8. Nambisan, K.M.P. 1992.Design Elements of Landscape Gardening, Oxford and IBH Publishing Co. (P) Ltd. Kolkatta.
9. Randhawa, G.S. 1973. Ornamental Horticulture in India. Today and Tomorrows Printers and publishers, New Delhi.

M.Sc. (Hort.) Plantation, Spice, Medicinal and Aromatic crops
Major Course

PSM 611 PRODUCTION TECHNOLOGY OF PLANTATION CROPS (2+1)

Objective

To impart basic knowledge about the importance and production technology of plantation crops grown in India.

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

Tea and coffee

Unit II

Rubber and cashew

Unit III

Coconut and arecanut

Unit IV

Palmyrah, oil palm and cocoa

Unit V

Wattle and betel vine

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.Areca nut

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 areca nut.

10. Processing of areca nut.

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 betelvine.

15. Description of botanical and varietal features of oil palm and wattle.

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

Reference books

1. Anonymous, 1985. Rubber and its Cultivation. The Rubber Board of India.

2. Chopra VL and Peter KV. 2005. Handbook of Industrial Crops. Panima.

3. Harler CR. 1963. The Culture and Marketing of Tea. Oxford Univ. Press.

4. Kurian A & Peter KV. 2007. Commercial Crops Technology. New India Publ. Agency.

5. Nair MK, Bhaskara Rao EVV, Nambiar KKN and Nambiar MC. 1979. Cashew. CPCRI, Kasaragod.

6. Peter KV. 2002. Plantation Crops. National Book Trust.

7. Pradeep Kumar T, Suma B, Jyothibhaskar and Satheesan KN. 2008. Management of Horticultural Crops. Part I, II. New India Publ. Agency.

8. Rai PS and Vidyachandran B. 1981. Review of Work Done on Cashew. UAS, Research Series No.6, Bangalore.

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11. Thampan PK. 1981. Hand Book of Coconut Palm. Oxford & IBH.

PSM 621 PRODUCTION TECHNOLOGY OF SPICE CROPS (2+1)

Objective

To impart basic knowledge about the importance, their export, employment potential and production technology of spices grown in India. The various aspects *viz.*, diversification of spices, value addition and constraints in this industry in India are also covered.

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

Black pepper, cardamom

Unit – II

Turmeric, ginger and garlic

Unit – III

Clove, cinnamon, nutmeg and allspice

Unit – IV

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

Unit –V

Tamarind, garcinia, vanilla and herbal spices

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:
- 3-5. Black Pepper
- 6-7. Cardamom
- 8-9. Turmeric
- 10-11. Ginger
- 12-13. Garlic
14. Clove
15. Cinnamon
16. Nutmeg
17. **Mid Semester Examination**
18. All spice
19. Coriander

20. Fenugreek
21. Cumin
22. Fennel
23. Ajowain
24. Dill
25. Celery
26. Tamarind
27. Garcinia
- 28-29. Vanilla
30. Herbal spices
31. Organic spice production
32. Precision farming practices in spice.
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 spices gardens
17. Visit to commodity boards

Reference Books

1. Agarwal S, Sastry EVD and Sharma RK. 2001. Seed Spices: Production, Quality, Export. Pointer Publ, Jaipur
2. Arya PS. 2003. Spice Crops of India. Kalyani Publishers, New Delhi.
3. Chadha KL and Rethinam P. (Eds.). 1993. Advances in Horticulture. Vols. IX-X. Plantation Crops and Spices. Malhotra Publ. House, New Delhi
4. Gupta S. (Ed.). Hand Book of Spices and Packaging with Formulae. Engineers India Research Institute, New Delhi.
5. Kumar NA, Khader P, Rangaswami and Irulappan I. 2000. Introduction to Spices, Plantation Crops, Medicinal and Aromatic Plants. Oxford and IBH .Publishing Co. Pvt Ltd., New Delhi
6. Nybe EV, Miniraj N and Peter KV. 2007. Spices. New India Publ. Agency, New Delhi.
7. Parthasarthy VA, Kandiannan V and Srinivasan V. 2008. Organic Spices. New India Publ. Agency, New Delhi.

8. Peter KV. 2001. Hand Book of Herbs and Spices. Vols. I-III. Wood Head Publ. Co. UK and CRC USA.
9. Pruthi JS. (Ed.). 1998. Spices and Condiments. National Book Trust, New Delhi.
10. Shanmugavelu KG, Kumar N and Peter KV. 2002. Production Technology of Spices and Plantation Crops. Agrobios, Jodhpur
11. Tiwari RS and Agarwal A. 2004. Production Technology of Spices. International Book Distr. Co, New Delhi.

PSM 623 PRODUCTION TECHNOLOGY OF MEDICINAL AND AROMATIC CROPS (2+1)

Objective

To impart comprehensive knowledge about the production technology of medicinal and aromatic 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

Senna, coleus, aswagandha, glory lily, sarpagandha

Unit II

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

Unit III

Isabgol, ipecac, periwinkle, poppy, safed musli, stevia

Unit IV

Palmarosa, lemongrass, citronella, vetiver, geranium, mentha, artemisia

Unit V

Ocimum, eucalyptus, rosemary, thyme, patchouli, lavender, marjoram, oreganum.

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. Aswagandha
7. Glory lily
8. Sarpagandha
9. Dioscorea and *Aloe vera*
10. Phyllanthus and kalmegh
11. Gymnema
12. Medicinal solanum and ipecac
13. Isabgol and safed musli
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 vetiver
22. Geranium and artemisia
23. Mint
24. Ocimum
25. Patchouli
26. Rosemary and thyme
27. Oreganum 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 aswagandha
3. Gymnema, sarpagandha and poppy
4. Phyllanthus, kalmegh and ipecac
5. Medicinal solanum, safed musli and dioscorea
6. Periwinkle, isabgol and stevia
7. Aromatic grasses
8. Geranium and mint
9. Ocimum and patchouli
10. Vetiver 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

Reference books

1. Atal CK and Kapur BM. 1982. Cultivation and Utilization of Aromatic Plants. RRL, CSIR, Jammu.
2. Atal CK and Kapur BM. 1982. Cultivation and Utilization of Medicinal Plants. RRL, CSIR, Jammu.
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4. Farooqi AA, Khan MM and Vasundhara M. 2001. Production Technology of Medicinal and Aromatic Crops. Natural Remedies Pvt. Ltd.
5. Hota D. 2007. Bio Active Medicinal Plants. Gene Tech Books.
6. Jain SK. 2000. Medicinal Plants. National Book Trust.
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8. Kurian A and Asha Sankar M. 2007. Medicinal Plants. Horticulture Science Series, New India Publ. Agency.
9. Panda H. 2002. Medicinal Plants Cultivation and their Uses. Asia Pacific Business Press.
10. Prajapati SS, Paero H, Sharma AK and Kumar T. 2006. A Hand book of Medicinal Plants. Agro Bios.
11. Ramawat KG and Merillon JM. 2003. BioTechnology-Secondary Metabolites. Oxford and IBH.
12. Skaria P Baby, Samuel Mathew, Gracy Mathew, Ancy Joseph, Ragina Joseph. 2007. Aromatic Plants. New India Publ. Agency.

PSM 711 BREEDING OF PLANTATION, SPICES, MEDICINAL AND AROMATIC CROPS (2+1)

Objective

To impart comprehensive knowledge about the principles and practices of breeding of plantation crops, spices, medicinal and aromatic 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, biotechnological approaches, marker-assisted selection, IPR issues, achievements and future thrusts of the following crops:

Unit I

Coffee, tea, cashew and cocoa

Unit II

Rubber, coconut, arecanut, palmyrah and oil palm

Unit III

Black pepper, cardamom, ginger and turmeric

Unit IV

Fenugreek, coriander, fennel, nutmeg, cinnamon and clove

Unit V

Aswagandha, aloe, senna, coleus, glory lily, stevia, dioscorea, medicinal yam, ocimum, phyllanthus, solanum, gymnema geranium, lemongrass, palmarosa, rosemary, patchouli, vetiver, and mint.

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 of plantation crops, spices, 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

Species and cultivars, cytogenetics, survey, collection, conservation and evaluation, blossom biology, objectives, approaches for crop improvement, introduction, selection, breeding methods, improvement of quality traits, biotechnological approaches, IPR issues, achievements and future thrusts of following crops:

- 1- 2. Tea
- 2-4. Coffee
5. Cashew
6. Cocoa
7. Rubber
8. Coconut
9. Arecanut
10. Palmyrah and oil palm
11. Black pepper
12. Cardamom
13. Ginger and turmeric
14. Fenugreek and coriander
15. Fennel and nutmeg,
16. Cinnamon and clove

17. Mid Semester Examination

Biodiversity, conservation of germplasm, IPPR issues, cytogenetics, breeding objectives, scope for introduction, selection, intra and interspecific hybridization, induced autotetraploidy, mutation breeding, biotechnological approaches, breeding for quality improvement, resistance for biotic and abiotic stresses and breeding problems of following crops:

18. Aswagandha
19. *Aloe vera*
20. Senna and coleus
21. Glory lily
22. Dioscorea sp
23. Medical yam
24. Ocimum sp
25. Periwinkle
26. Solanum sp
27. Gymnema
28. Geranium
29. Vetiver

30. Lemongrass
31. Palmarosa
32. Rosemary
33. Patchouli
34. Mint.

Practical schedule

1. Study of floral biology, anthesis and practicing selfing techniques in plantation crops.
2. Practices in *in-vitro* approaches in improvement of plantation crops.
3. Characterization, evaluation and screening of germplasm accessions in major plantation crops.
4. Study of floral biology, anthesis and crossing techniques in spice crops.
5. Induction of mutation and polyploidy in spices and plantation crops.
6. Characterization, evaluation and screening of germplasm accessions in major spice crops.
7. Practices in *in-vitro* approaches in improvement of spice crops.
8. Study of floral biology, anthesis and pollination mechanism in medicinal crops.
9. Characterization, evaluation and screening of germplasm accessions in medicinal crops.
10. Characterization, evaluation and screening of germplasm accessions in aromatic crops.
11. Introduction of mutation and polyploidy in medicinal and aromatic crops
12. Practices in *in-vitro* approaches in improvement of medicinal crops.
13. Practices in *in-vitro* approaches in improvement of aromatic crops.
14. Visit to radiation laboratory.
15. Visit to commercial oil extraction units.
16. Visit to National institutes.

Reference books

1. Anonymous 1985. Rubber and its Cultivation. The Rubber Board of India.
2. Atal CK & Kapur BM. 1982. Cultivation and Utilization of Medicinal Plants. RRL, CSIR, Jammu
3. Chadha KL, Ravindran PN & Sahijram L. 2000. Biotechnology in Horticultural and Plantation Crops. Malhotra Publ. House.
4. Chadha KL. 1998. Advances in Horticulture. Vol. IX. Plantation and Spice Crops. Malhotra Publishing House, New Delhi.
5. Farooqi AA, Khan MM & Vasundhara M. 2001. Production Technology of Medicinal and Aromatic Crops. Natural Remedies Pvt. Ltd.
6. Ferwerden FP & Wit F. (Ed.). 1969. Outlines of Perennial Crop Breeding in the Tropics. H. Veenman & Zonen.
7. Harver AE. 1962. Modern Coffee Production. Leonard Hoff.
8. Jain SK. 2000. Medicinal Plants. National Book Trust.
9. Prajapati ND, Paero Hit SS, Sharma AK, Kumar T. 2006. A Hand book of Medicinal Plants. Agro Bios (India).
10. Raj PS & Vidyachandra B. 1981. Review of Work Done on Cashew. UAS Research Series No.6, Bangalore.

M.Sc. (Horticulture)
Supportive Courses

STA 611 – STATISTICAL METHODS AND DESIGN OF EXPERMENTS (2+1)

Unit I Concepts in Statistics

Population and sample, parameter and statistic. Concept of Sampling, Simple random Sampling – Concept of Probability distribution, Binominal, Poisson and Normal distributions. F and Chi square distribution. Estimation: Point estimation, interval estimation, Degrees of freedom. Concept of Sampling distribution, Standard Error. Tests of Significance based on t, z, (Mean and equality of Means only). X^2 test for goodness of fit.

Unit II Correlation and Regression

Definition, types and methods of studying correlation, Properties of correlation coefficient. Regression – Measuring and uses of Regression analysis, Properties. Differences between correlation and regression. Regression co – efficient - simple, linear, multiple linear regression co – efficient, standard error of estimate, test of significance of observed regression co - efficient and co - efficient of determination, Non linear regression. Misuses of correlation and regression in agricultural research.

Unit III Basic Designs

Agricultural experiments: Concepts, field studies, pot-culture, quantitative and qualitative variables. Errors: Sources of errors and estimate of errors. Basic principles of Design of Experiments, CRD, RBD, LSD layout and their analysis , efficiency.

Unit IV: Mean comparison and Missing data

Comparison of treatments – Least significant Difference method – Duncan’s Multiple Range Test (DMRT). Missing plot technique in RBD and LSD (one and two missing). Concept of analysis of Covariance. Data transformation: Logarithmic square root and arc sine.

Unit V: Factorial Experiments

Concept of factorial experiments – 2^n , 3^2 Factorial experiments, Principle of confounding in factorial experiments – confounding in 2^3 Factorial experiments. Split-pot design and strip – plot design.

PRACTICAL

Estimation of samples statistic *viz.*, means, SD, SE and CV. Z-test, t-test and paired t-test. Comparison of two variances using F-test. Bartlett’s test for homogeneity of variances. Chi-square test for test of goodness of fit and homogeneity of ratio test for independence of attributes. Computation of correlation co-efficient and its significance. Fitting of simple linear regression and testing the significance of regression co-efficient. Multiple linear regressions fitting and testing Determination of optimum plot size using uniformity trial. Analysis of CRD, RBD, LSD and DMRT. Analysis of multi-observation data (sampling in RBD) Missing plot technique in RBD with one or two missing values. Analysis of Factorial experiments conducted in RBD Analysis of Split-plot and Split-plot design. Analysis of data with transformations.

Theory schedule:

1. Definition of Population and sample
2. Difference between parameter and statistic
3. Concept of Sampling – Simple random Sampling
4. Concept of Probability distribution – Binominal, Poisson and Normal distributions.
5. F and Chi square distribution
6. Estimation - Point estimation, interval estimation, Degrees of freedom.
7. Concept of Sampling distribution – Standard Error.

8. Tests of Significance based on t, z, (Mean and equality of Means only). χ^2 test for goodness of fit.
9. Definition of correlation, significance & types
10. Properties of correlation coefficient
11. Definition of regression – Measuring and uses of Regression analysis – Properties.
12. Differences between correlation and regression.
13. Regression co – efficient - simple, linear –
14. Multiple linear regression co - efficient – standard error of estimate
15. Test of significance of observed regression co -efficient and co - efficient of determination –
16. Non linear regression. Misuses of correlation and regression in agricultural research.

17. Mid semester examinations

18. Characteristics of Agricultural experiments: Concepts – field studies –
19. Characteristics of Agricultural experiments -pot-culture – quantitative and qualitative variables.
20. Sources of errors and estimate of errors
21. Design of Experiments– Basic principles of CRD
22. Design of Experiments– Basic principles of RBD
23. Design of Experiments– Basic principles of LSD
24. Efficiency of designs -layout and their analysis
25. Comparison of treatments – Least significant Difference method
26. Duncan's Multiple Range Test (DMRT).
27. Missing plot technique in RBD and LSD (one and two missing).
28. Concept of analysis of Covariance
29. Data transformation: Logarithmic square root and arc sine.
30. Concept of factorial experiments
31. 2^n , 3^2 Factorial experiments,
32. Principle of confounding in factorial experiments
33. Confounding in 2^3 Factorial experiments.
34. Split-pot design and strip – plot design.

PRACTICAL SCHEDULE:

1. Estimation of samples statistic *viz.*, means, SD, SE and CV.
2. Z-test, t-test and paired t-test.
3. Comparison of two variances using F-test
4. Bartlett's test for homogeneity of variances.
5. Chi-square test for test of goodness of fit and homogeneity of ratio test for independence of attributes.
6. Computation of correlation co-efficient and it's significance.
7. Fitting of simple linear regression and testing the significance of regression co-efficient.
8. Multiple linear regressions fitting and testing
9. Determination of optimum plot size using uniformity trial.
10. Analysis of CRD.
11. Analysis of RBD
12. Computation of LSD and DMRT
13. Analysis of multi-observation data (sampling in RBD)
14. Missing plot technique in RBD with one or two missing values.
15. Analysis of Factorial experiments conducted in RBD
16. Analysis of Split-plot and Split-plot design.

17. Analysis of data with transformations.

REFERENCE BOOKS

1. Bhattacharyya, G.K. and Johnson, R.A. 1997. Statistical concepts and methods, John Wiley and Sons, New York.
2. Crozon, F.E. and Cowden, D.J. 1986. Applied General Statistics, Prentice Hall of India, New Delhi.
3. Gomez, K.A. and Gomez, A.A. 1984. Statistical procedure for Agricultural Research, John Wiley and Sons, New York.
4. Panse, V.G. and Sukhatme, P.V. 1961. Statistical methods for Agricultural Workers, ICAR, New Delhi.
5. Ramaswamy, R, 1995. A text book of Agricultural Statistics, Wiley Limited, New Delhi.

COM 615 Computer Applications for Agricultural Research (1+1)

Objectives

To understand the basic concepts of computer and their peripherals, to get the knowledge in office automation tools like MS Word, MS Excel, and MS Access. And to get exposed to the current trends in the internet and their usages. And also to make them acquire sound knowledge in various Agricultural statistical software and their analysis.

Theory

Unit I Introduction to Computer

Overview of computers - basic principle of operation - devices of a computer and their functions - current trends in hardware and software. Computer applications - Operating systems - DOS - Windows - feature of windows - version of windows.

Unit II Word Processor

MS Word - Creation, Editing and Printing of a document - using the features of word like page setting, underlining, bold, italics, spell check, grammar check etc.-creation of tables in word, inserting graphics.

Unit III Data Processing & Database

MS Excel - creation of excel sheet - statistical analysis using the features in excel. MS Access - creation of database and retrieval - Query - Applications to Agricultures.

Unit IV Agricultural Statistical Software

SAS, MSTAT, IRRISTAT, AGRES, AGRISTAT, STATISTICA- MANOVA AND MANCOVA.

Unit V Internet

Internet Definition - getting the connectivity - service providers - web – sites – home page – email – retrieval of information from internet.

Theory Schedule

- 1) Introduction to computers, input, output devices and their operation.
- 2) Components of computers (hardware and software) and their applications.
- 3) Booting sequences of operating system (DOS, WINDOWS) and their features.
- 4) Introduction to word processor and their special features.
- 5) Creating, editing printing of a document, Formatting features (underline, bold, italic etc) and operation of table.
- 6) Introduction to data processing and creation of excel sheets, Working with different built-in-function.
- 7) Creating different types of graphs and working procedures of various statistical functions.

- 8) Importing and exporting objects among different application (MS-word, MS-excel, MS-access).
- 9) Mid semester Examination.
- 10) Database and MS- access- Creation, storing and retrieval of data from database.
- 11) Working of various statistical function (mean, variance, sd, T test etc).
- 12) SAS, MSTAT, IRRISTAT.
- 13) AGRES, AGRISTAT.
- 14) STATISTICA-MANOVA AND MANCOVA.
- 15) Introduction to internet, Features of internet.
- 16) Need for Internet service provider, creation and working principle of E-mail.
- 17) Information retrieval from various web pages of internet.

Practical Schedule

- 1) Introduction to hardware, software and operating systems.
- 2) Study of various DOS commands.
- 3) Creating and Editing of a word Document.
- 4) Study of various features in MS-WORD (spelling and grammar check, protection of a document).
- 5) Operation of tables and Mail-merge.
- 6) Working with different statistical packages in MS-EXCEL.
- 7) Drawing of different graphs for the given data.
- 8) Various string operations (Concatenation, count, left string, right string, type conversion etc.).
- 9) Table creation using wizards.
- 10) Forms and reports.
- 11) Retrieval of data from the database using queries.
- 12) Correlation and multiple regression analysis.
- 13) T test and Chi-square test, Creation of data file systat and importing a data file from other packages.
- 14) SAS, MSTAT, IRRISTAT.
- 15) AGRES, AGRISTAT, STATISTICA.
- 16) Creating E-Mail account (sending and receiving mails), Information retrieval from Internet.
- 17) Model Practical Examinations

References Books

1. Kapoor V.K. 2004. Introduction to computers and Information systems. New Delhi: Sultan Chand and sons.
2. Karthy Jacobs. 2007 “Microsoft office Excel”, The Express Line to Learning, Willey Chand & Sons, New Delhi.
3. Peter Norton’s 2001, “Introduction to Computer (4th edition)”, Tata McGraw-Hill Publishing Company Limited, New Delhi.
4. TNAU 2004, “Advanced Quantitative Techniques and Data Analysis” Training Manual- Argl. Engineering College and Research Institute, Coimbatore.

M.Sc. (Horticulture)
Non Credit Compulsory Subjects
PGS 611 **Basic concepts in Laboratory Techniques (0+1)

Objective: To acquaint the students about the basics of commonly used techniques in laboratory
Practical

Unit I Safety measures and common laboratory equipments

Safety measures while in labs; Handling of chemical substances; Use of burettes, pipettes, measuring cylinders, flasks, separatory funnel, condensers and micropipettes. Washing, drying and sterilization of glassware; Drying of solvents /chemicals

Unit II Preparation of standard solutions

Weighing and preparation of solutions of different strengths and their dilution; Handling techniques of solutions; Preparations of different agro-chemical doses in field and pot applications; Preparation of solutions of acids; Neutralisation of acid and bases; Preparation of buffers of different strengths and pH values

Unit III Use and handling of laboratory equipments

Use and handling of vacuum pumps, viscometer, thermometer, magnetic stirrer, micro-ovens, incubators, sand bath and water bath.

Unit IV Microscopy and media preparation

Use and handling of microscope and laminar flow - Preparation of media – differential, selective and enriched media. Methods of sterilization – physical methods- dry and moist heat, cold, filtration and radiation, chemical methods and disinfectants.

Unit V In-vitro culture Techniques

Description of flowering plants in botanical terms in relation to taxonomy – seed viability test – pollen fertility test – tissue culture media – composition of media – media preparation – instant media – Aseptic manipulations – Autoclaving, flame sterilization – filter sterilization – Hot water sterilization – procedure for in vitro culture of explants – leaf bit – stem bit – anthers – pollen – microspores – ovule and embryo

Practical Schedule:

1. Safety measures in labs and handling of chemical substances
2. Common Laboratory equipments
3. Calibration and cleanliness of volumetric glass wares
4. Methods of expressing strength of solutions
5. Preparation of primary standard solutions and buffer solutions
6. Preparation of standard solutions for nutrient analysis of soil, plant and water.
7. Preparation of different agro-chemical doses for field experiments
8. Preparation of buffer solutions
9. Mid- Semester
10. Handling of Instruments- Vacuum pumps, thermometers, magnetic stirrer
11. Handling of instruments - Ovens, sand bath and water bath.
11. Handling and uses of microscopes and laminar flow
12. Sterilization by physical methods
13. Sterilization by chemical methods
14. Preparation of different media for culturing the micro organisms.
15. Description of flowering plants – seed viability test and pollen fertility test
16. Aseptic manipulations and media
17. In vitro culture of different explants

Reference Books:

1. Furr, A.K. 2000. CRC Handbook of Laboratory safety. CRC press.
2. Jackson, M.L. 1997. Soil Chemical Analysis. Prentice Hall of India Pvt. Ltd., New Delhi.
3. Prescott, L.M., P. Harley and A. Klein. 2003. Microbiology, 5th Edition, Mc.Graw Hill, USA.
4. Gupta, P.K. 1997. Elements of Bio technology, Rastogi Publications. Meerut.
5. Singh, B.D. 2005. Bio technology, Expanding Horizons, Kalyani Publications, New Delhi.

PGS 622 **Technical writing and communication skills (0+1)**Objective**

To equip the students with skills *Viz.*, writing of dissertations, research papers, etc. and to communicate and articulate in English

Practical

Grammar - Tenses, parts of speech, clauses, punctuation marks; Error analysis - Common errors; Concord; Collocation; Phonetic symbols and transcription; Accentual pattern: Weak forms in connected speech: Participation in group discussion: Facing an interview; presentation of scientific papers. Proof reading.

Technical Writing - Various forms of scientific writings- theses, technical papers, reviews, manuals, etc; Structure of thesis and research communications (title page, authorship contents page, preface, introduction, review of literature, material and methods, experimental results and discussion); Writing of abstracts, summaries, précis, citations etc.; commonly used abbreviations in the theses and research communications; illustrations, photographs and drawings with suitable captions; pagination, numbering of tables and illustrations; Writing of numbers and dates in scientific write-ups; Editing and proof-reading; Writing of a review article.

Practical schedule

1. Grammar (Tenses, parts of speech)
2. Grammar (clauses, punctuation marks)
3. Error analysis (Common errors); Concord; Collocation;
4. Phonetic symbols and transcription;
5. Accentual pattern: Weak forms in connected speech
6. Participation in group discussion
7. Facing an interview; presentation of scientific papers.
8. Technical Writing- Various forms of scientific writings- theses, technical papers
9. Mid -semester
10. Technical Writing- reviews, manuals
11. Structure of thesis and research communications
12. Writing of abstracts, summaries, précis, citations etc
13. Commonly used abbreviations in the theses and research communications
14. Illustrations, photographs and drawings with suitable captions
15. Pagination, numbering of tables and illustration, numbers and dates in scientific write-ups
16. Editing and proof-reading
17. Writing of a review article.

Suggested Readings

1. Joseph G. 2000. MLA Handbook for Writers of Research Papers. 5th Ed. Affiliated East-West Press.
2. Mohan K. 2005. Speaking English Effectively. MacMillan India.
3. Richard WS. 1969. Technical Writing. Barnes & Noble.
4. Robert C. (Ed.). 2005. Spoken English: Flourish Your Language. Abhishek.
5. Wren PC & Martin H. 2006. High School English Grammar and Composition. S.Chand & Co.

PGS 623 Intellectual Property and Its Management in Agriculture (1+0) (E-course)

Objective

The objective of the course is to create awareness about intellectual property rights in agriculture. The course deals with management of patents, trademark, geographical indications, copy rights, designs, plant variety protection and biodiversity protection. The students will be taught on the Marketing and Commercialization of Intellectual Properties.

Theory

Unit - I: World Trade Organization – Introduction

World Trade Organization - Agreement on Agriculture (AoA) and Intellectual Property Rights (IPR) - Importance of Intellectual Property Management - IPR and Economic growth - IPR and Bio diversity - Major areas of concern in Intellectual Property Management - Technology Transfer and Commercialization - Forms of different Intellectual Properties generated by agricultural research.

Unit - II: Patent Document

Discovery *versus* Invention - Patentability of Biological Inventions - Procedure for patent protection - Preparatory work - Record keeping, writing a patent document, filing the patent document - Types of patent application - patent application under the Patent cooperation treaty (PCT).

Unit - III: Plant Genetic Resources

Plant genetic resources - Importance and conservation - Sui Generic System – Plant Varieties Protection and Farmers' Rights Act - Registration of Extant varieties - Registration and protection of New Varieties / Hybrids / Essentially Derived Varieties - Dispute prevention and settlement - Farmers' Rights.

Unit - IV: Trademark

Trademark - Geographical Indications of Goods and Commodities – Copy rights- Designs – Biodiversity Protection.

Unit – V: Benefit Sharing

Procedures for commercialization of technology - Valuation, Costs and Pricing of Technology - Licensing and implementation of Intellectual Properties - Procedures for commercialization – Exclusive and non exclusive marketing rights - Research Exemption and benefit sharing .

Theory Schedule

1. World Trade Organization - Agreement on Agriculture (AoA) and Intellectual Property Rights (IPR)
2. Importance of Intellectual Property Management - IPR and Economic growth - IPR and Bio diversity
3. Major areas of concern in Intellectual Property Management -Technology Transfer and Commercialization
4. Forms of different Intellectual Properties generated by agricultural research.

5. Discovery *versus* Invention Patentability of Biological Inventions
6. Procedure for patent protection
7. Preparatory work - record keeping, writing a patent document, filing the patent document
8. Types of patent application - patent application under the Patent cooperation treaty (PCT). Plant genetic resources
- 9. Mid Semester Examination**
10. Importance and conservation
11. Sui Generis System – Plant Varieties Protection and Farmers’ Rights Act - Registration of Extant varieties
12. Registration and protection of New Varieties / Hybrids / Essentially Derived Varieties - Dispute prevention and settlement
13. Farmers' Rights. Trade mark - Geographical Indications of Goods and Commodities – Copy rights - Designs
14. Biodiversity Protection.
15. Procedures for commercialization of technology - Valuation, Costs and Pricing of Technology
16. Licensing and implementation of Intellectual Properties - Procedures for commercialization
17. Exclusive and non exclusive marketing rights - Research Exemption and benefit sharing.

Reference Books

1. Arun Goyal, and Moor Mohamed, 2001, *WTO in the New Millennium*, Academy of Business Studies, New Delhi.
2. Bilek Debroy, 2004, *Intellectual Property Rights*, BR World of books, New Delhi
3. Ganguli, P. 2001. *Intellectual Property Rights –Unleashing the Knowledge Economy*. Tata McGraw Hill, New Delhi.
4. Narayanan, R., 2006, *Patent Law*, Eastern Law house, New Delhi.
5. Ramappa, T., 2000, *Intellectual Property Rights under WTO – Tasks before India*, Wheeler Publishing, New Delhi.

PGS 714 ** LIBRARY AND INFORMATION SERVICES (0+1)

Objective

To equip the library users with skills to trace information from libraries efficiently, to apprise them of information and knowledge resources, to carry out literature survey, to formulate information search strategies, and to use modern tools (Internet, OPAC, search engines etc.) of information search.

Practical

Introduction to library and its services; Role of libraries in education, research and technology transfer; Classification systems and organization of library; Sources of information-Primary -Sources, Secondary Sources and Tertiary Sources; Intricacies of abstracting and indexing services - (Science Citation Index, Biological Abstracts, Chemical Abstracts, CABI Abstracts, etc.); Tracing - information from reference sources; Literature survey; Citation techniques/Preparation of bibliography; Use of CD-ROM Databases, Online Public Access Catalogue and other computerized - library services; Use of Internet including search engines and its resources; e-resources access methods.

Practical Schedule

1. Introduction to library and its services

2. Role of libraries in education, research and technology transfer;
3. Classification systems and organization of library
4. Sources of information- Primary –Sources
5. Sources of information -Secondary Sources and Tertiary Sources
6. Intricacies of abstracting and indexing services
7. Science Citation Index, Biological Abstracts, Chemical Abstracts, CABI Abstracts, etc.);
8. Tracing - information from reference sources; Literature survey
9. Mid- Semester
10. Citation techniques/Preparation of bibliography;
11. Use of CD-ROM Databases,
12. Online Public Access Catalogue and other computerized - library services
13. Online Public Access Catalogue and other computerized - library services
14. Use of Internet including search engines and its resources
15. Use of Internet including search engines and its resources
16. e-resources access methods.
17. e-resources access methods.

PGS 725 ** DISASTER MANAGEMENT (1+0)
(e-Course)

Objectives

To introduce learners to the key concepts and practices of mitigation for natural disasters and calamities and to equip them to conduct thorough assessment of hazards, risks vulnerability and capacity building strategies.

Theory

UNIT I

Natural Disasters - Meaning and nature of natural disasters, their types and effects. Floods, drought, cyclone, earthquakes, landslides, avalanches, volcanic eruptions, Heat and cold waves.

UNIT II

Climatic change: Global warming, Sea level rise, Ozone depletion, Man Made Disasters- Nuclear disasters, chemical disasters, biological disasters.

UNIT III

Building fire, coal fire, forest fire. oil fire, air pollution, water pollution, deforestation, Industrial waste water pollution, Disaster Management- Efforts to mitigate natural disasters at national and global levels.– India's Key Hazards, Vulnerabilities and Disaster Response Mechanisms in India-

Unit IV

Concept of disaster management, national disaster management framework; financial arrangements, role of NGOs, Community-based organizations, and media-Central, state, district and local administration. Dissemination of Disaster Warning, Response to natural disasters, national, state, district level, relief , food & nutrition , water , health , mental health services.

Unit V

Rehabilitation, tolerant and resistant crops- Resilient farming concepts , Bioshields Livelihood options, insurance and compensation-Clothing & utensils & fuel , shelter , relief camp , Sanitation and Hygiene. Preparedness , Emergency Operations Centres (EOCS).

Lecture Schedule

1. Natural Disasters Meaning and nature of natural disasters, their types and effects –
2. Floods, drought, cyclone, earthquakes Landslides, avalanches, volcanic eruptions, Heat and cold waves.
3. Climatic change- Global warming, Sea level rise, Ozone depletion
4. Man Made Disasters- Nuclear disasters, chemical disasters, biological disasters
5. Building fire, coal fire, forest fire. oil fire,
6. Air pollution, water pollution, deforestation, Industrial wastewater pollution
7. Disaster Management- Efforts to mitigate natural disasters at national and global levels.
8. Mid-Semester
9. India's Key Hazards, Vulnerabilities and Disaster Response Mechanism in India
10. Concept of disaster management, national disaster management framework
11. Financial arrangements, role of NGOs, Community-based organizations, and media-
12. Central, state, district and local administration
13. Dissemination of Disaster Warning - Response to natural disasters, national, state, district level
14. Relief – food & nutrition – water – health – mental health services
15. Rehabilitation – tolerant and resistant crops- Resilient farming concepts – Bioshields Livelihood options – insurance and compensation-
16. Clothing & utensils & fuel – shelter – relief camp – Sanitation and Hygiene.
17. Preparedness – Emergency Operations Centres (EOCS).

Reference Books

1. Gautam D R 2009. Community Based Disaster Risk Reduction –, Mercy Corps, Lalitpur, Nepal.
2. Gupta HK. 2003. Disaster Management. Indian National Science Academy. Orient Blackswan.
3. Hodgkinson PE & Stewart M. 1991. Coping with Catastrophe: A Handbook of Disaster Management. Routledge.
4. Ministry of Home Affairs. 2010. Standard Operating Procedure for responding to natural disasters, Ministry of Home Affairs – Disaster management Division, New Delhi.
5. Sharma VK. 2001. Disaster Management. National Centre for Disaster Management, India.