



**ANNAMALAI UNIVERSITY**  
**FACULTY OF AGRICULTURE**



**DEGREE OF BACHELOR OF SCIENCE IN AGRICULTURE**  
**WITH EFFECT FROM 2012 – 2013**

**System of Education: Formal Education with Semester System**

**REGULATIONS**

- Candidates for admission to the degree of **Bachelor of Science in Agriculture B.Sc.(Ag.)** – shall be required to have passed the Higher Secondary Course (10+2) or any other examination recognized as equivalent there to and fulfilling the following requirements

**A. Eligible Subjects of Study in the Qualifying Examination**

HSC/ Equivalent- Academic Stream

- Mathematics / Botany / Biology as first subject.
- Physics as second subject.
- Chemistry as third subject.
- One elective as fourth subject\*

Subjects of study are grouped below

Subject 1	Subject 2	Subject 3	Subject 4 (elective subject)*
Biology	Physics	Chemistry	Computer Science/ Micro biology/Biotechnology/ Biochemistry/Nursing/ Nutritional Dietetics
Botany	Physics	Chemistry	Zoology
Mathematics	Physics	Chemistry	Biology/Computer Science/ Statistics/Biochemistry/ Home science

\*Incase of failure to qualify with the first three subjects, his marks in the subject listed as fourth will be considered for calculating eligible minimum qualifying aggregate marks. The aggregate marks will be computed using the following formula

$$\frac{\% (\text{Sub 1}) + \% (\text{Sub 2}) + \% (\text{Sub 3})}{3} \times 2 = \boxed{\phantom{00}}$$

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**(or)**

$$\frac{\% (\text{Sub 1}) + \% (\text{Sub 2}) + \% (\text{Sub 3}) + \% (\text{Sub 4})}{4} \times 2 = \boxed{\phantom{00}}$$

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**B. HSC/ Equivalent**

Biology with three vocational subjects.

**C. Eligible Minimum Qualifying Marks**

**C1.** Open Competition (OC): *50 % aggregate in the qualifying subjects as mentioned above.*

**C2.** Backward Class (BC), Backward Class Christians (BCC) and Backward Class Muslims (BCM): *45 % aggregate in the qualifying subjects as mentioned above.*

**C3.** Most Backward Class (MBC) / De notified Community (DNC): *40 % aggregate in the qualifying subjects as mentioned above.*

**C4.** Scheduled Caste (SC)/ Scheduled Tribe (ST): *A pass in qualifying examination with above qualifying subjects.*

**D. Number of Attempts to Pass**

The maximum number of attempts to pass the qualifying examination for admission to all the courses are as follows

Sl. No.	Community	Maximum Number of Attempts
1	Scheduled Caste / Scheduled Tribe	Three
2	All others Communities	Two

### E. Award of B.Sc.(Ag.) Degree

The candidates should have undergone successfully the prescribed course of study in the University. They shall further be required to have completed and passed 165 course credits and shall have earned an overall grade point average (OGPA) of 5.50 out of 10 for all courses completed in B.Sc.(Ag.) degree programme. In addition to the above, students shall in the judgment of the Faculty, possess good conduct and character.

2. The syllabi for the courses shall be prescribed from time to time by the Academic Council on the recommendations of the Board of Studies.
3. The B.Sc.( Ag.) degree course shall be of four academic years. Each academic year shall comprise two semesters as shown below.

I Year B.Sc.(Ag.)	-	Semester I and II
II Year B.Sc.(Ag.)	-	Semester III and IV
III Year B.Sc.(Ag.)	-	Semester V and VI
IV Year B.Sc.(Ag.)	-	Semester VII and VIII

4. **SEMESTER DURATION:** A Semester consists of 110 working days including semester examination days.

### 5. DEFINITIONS

- 5.1. "Course" is a teaching unit of a discipline to be covered within a semester as detailed in the curricula and syllabi issued by the University.
- 5.2. A "Credit" in theory means 60 minutes of class room lecture plus two hours of library or homework, and a "Credit" in practical means two hours of laboratory or three hours of field work per week.
- 5.3. "Curriculum" is a group of courses and other specified requirements for the fulfillment of the degree programme.
- 5.4. "Credit load" of a student during a semester is the total number of credits of all the courses he/she registers during that particular semester.
- 5.5. "Grade Point" means the total marks in percentage divided by 10 and rounded to two decimals.
- 5.6. "Credit Point" means the grade point multiplied by credit.
- 5.7. "Overall Grade Point Average" (OGPA) means the total credit points of the courses completed by the student divided by total credit hours of the course and rounded to two decimals. The OGPA shall be the basis to determine the student's merit and to decide whether or not a student meets the academic requirements for getting the degree.
- 5.8. "Transcript Card" is a consolidated report of grades secured by the student issued by the University.
  - a) The result of evaluation of a course shall be indicated by grade points ranging from 0 to 10. Grade point is the total marks in percentage divided by 10. The minimum grade point to be secured for the successful completion of a course will be 5.00; Less than 5.00 will be treated as 'F' grade and the grade point will be 0 for calculating the GPA/OGPA.
  - b) The following symbols shall be used in the grade sheets.

E	-	Incomplete (due to attendance deficiency)
F	-	Failed
RR	-	Re registration
SE	-	Supplementary Examination
IE	-	Improvement Examination
EE	-	Incomplete for reasons other than attendance

### 6. EXAMINATIONS

Each course shall carry a maximum of 100 marks for the purpose of grading. The distribution of marks shall be as follows.

6.1. Course with both theory and practical	Marks
i) Mid Semester Examination	20
ii) Practicals, records, term papers and other assignments including field trips, if any, (Written = 25, Record = 5 Specimen collection = 5 and Viva-Voce = 5)	40
iii) Final Theory Examination	40
<b>Total</b>	<b><u>100</u></b>

<b>6.2. Course with only Theory / Practical*</b>	<b>Marks</b>
i) Mid Semester Examination	40
ii) Final Semester Examination	60
<b>Total</b>	<b>100</b>

\* Except three courses: NSS / NCC, RAWE and Experiential learning the distribution of marks of these courses are furnished in Regulations 6.4 to 6.6.

**6.3.** A student should secure a minimum of 50 per cent of marks in the aggregate and 45 per cent of marks in theory and practical separately to successfully complete a course. The candidate who does not satisfy the above criteria shall be awarded 'F' grade.

#### **6.4. NSS / NCC (0+1)**

The duration of NCC / NSS training is for four semesters (I,II,III and IV).

#### **NSS**

Each student enrolled in NSS should serve in four semesters (I, II, III and IV). He / She should also attend at least one special camp not exceeding 10 days duration. Marks will be awarded as follows.

	<b>Marks</b>
NSS Regular Programme	60
NSS Special camp not exceeding 10 days duration	40
<b>Total</b>	<b>100</b>

At the end of the fourth semester the course teacher shall send the marks awarded to the Controller of Examinations through the Dean, Faculty of Agriculture.

#### **NCC**

Each student enrolled in NCC should attend 10 parades per semester. Marks will be awarded at the rate of two marks per parade (2 x 40 = 80). The final semester examination will be for 20 marks. There will be no supplementary examination for the final NCC examination.

#### **Rural Agricultural Work Experience (RAWE)**

Course on Rural Agricultural Work Experience will be offered in the VII Semester:

The village attachment will be organized by the Department of Agricultural Extension. The components of Agri Clinic / Input Industry / NGO / Financial Institutions / and attachment to Agro based industries will be organized by Department of Agricultural Economics. Orientation programme will be organized in the first week of the semester by both the departments. Crop Production and Crop Protection components of RAWE program will be evaluated by the concerned course teachers based on the skills learned by the students in their village stay programme. The marks awarded by the examiners will be apportioned for the titles listed in table below. The credit load for the departments and appointment of examiners for evaluation will be on a group teaching mode involving the departments taking up the assignment.

<b>S.No.</b>	<b>Course code</b>	<b>RAWE</b>	<b>Credit Hours</b>
1.	RAE-411	<b>Crop Production</b> (Agronomy (0+2), Plant Breeding (0+1), Soil Science (0+1), Animal Husbandry(0+1))	0+5
2.	RAE-412	<b>Crop Protection</b> (Agronomy (0+1), Entomology (0+1), Plant Pathology (0+1), Micro Biology (0+1))	0+4
3.	RAE-413	<b>Extension Programme – Village stay programme – 6 weeks</b> (Agricultural Extension)	0+4
4.	RAE-414	<b>Rural Economics – Industrial attachment – 12 weeks</b> (Agricultural Economics) Attachment to Industry (Agro Industrial Tie-Up ) – 3 weeks Agri Clinics / Agri Business Centers – 2 weeks NGO Organization / Agri related government institutions – 2 weeks Agricultural Finance Institutions / Banks / RRB / Cooperative Societies / MFI – 3 weeks Seed / Fertilizer / Pesticide / Input Industry – 2 weeks Total - 12 weeks	0+7
<b>Orientation – 1 week</b>			
<b>Project report presentation and Examination – 1 week</b>			
<b>Total</b>			<b>0+20</b>

**Evaluation:**

**a) RAE-411 Crop Production and RAE-412 Crop Protection**

1. Observation note book	- 20	}	By the teacher in-charge
2. Field works / Demonstration record	- 20		
3. Technology learned and commendable Activities	- 10	}	By the examiners
4. Project report	- 30		
5. Viva-voce	- 20		
Total	100		

**b) RAE-413 Agrl. Extension**

1. Daily record (Observation note book)	- 20	}	By the teacher in-charge
2. Skills learned	- 20		
3. Commendable Activities	- 10	}	By the examiners
4. Village stay programme record	- 30		
5. Viva-voce	- 20		
Total	100		

**c) RAE-414 Agricultural Economics**

**i) Visit to NGO/Agri clinic/Input Industry / Agricultural Finance Institutions**

• Daily Record	- 20
• Project Report	- 20
Total	40

**ii) Agro Industrial Tie-Up**

• Daily observation note book	- 20
• CD preparation/Project report	- 20
• Viva-voce	- 20
Total	60

**6.5. Experiential learning (0+5) :** This course will be offered in the VIII semester. The credit load for the departments involved in experiential learning, the appointment of examiners for evaluation will be on a group teaching mode involving the departments taking up the module courses in experiential learning. The experiential learning examination will be conducted by the University before the commencement of regular final semester examinations. The distribution of marks will be 40 for periodical evaluation and 60 for final examination. The evaluation will comprise of skills learnt, proficiency in project execution, project report and viva-voce

Evaluation	Marks	
1. Daily Record (Observation note book)	20	} By the teacher in-charge
2. Skills learned	20	
3. Proficiency in project execution	10	} By the Examiners
4. Project Report	30	
5. Viva-Voce	20	
<b>Total</b>	<b>100</b>	

## 7. MID-SEMESTER EXAMINATION (MSE)

- 7.1. The appearance of the candidate for the mid-semester examinations is compulsory. If a student does not appear for MSE he/she is not eligible to appear for the final examinations. Such candidate has to reappear for the MSE as and when the respective examinations are conducted only after getting permission from the Dean, Faculty of Agriculture two weeks before the schedule of MSE on payment of fee prescribed by the University. They will be conducted by the Dean, Faculty of Agriculture. The answer scripts will be shown to the student after valuation, retained for 10 days and returned to the course teacher. The Head of the Department/Division will be responsible to ensure the distribution of answer papers to the students.
- 7.2. The MSE marks will not be shown separately in the grade sheet but will be combined with the respective final theory and practical marks. MSE marks awarded in a course will be added to the supplementary examinations also.
- 7.3. The MSE marks will be furnished to the Dean, Faculty of Agriculture through HOD's within 10 days after the conduct of MSE. If the student is not satisfied with the award of the marks, he/she shall appeal to the Dean, within three working days after the announcement of marks. The appeal will be considered and the results reviewed by a cell consisting of the Dean and the Head of the Department /Division of Studies concerned. The decision of the Review Cell shall be final. If the H.D. himself is the course teacher, one senior member of the department concerned shall be nominated by the Dean.
- 7.4. The MSE of theory will be one hour duration for 20 marks which will be apportioned as shown below.

	<b>Marks</b>
i) Objective questions @ ½ mark for 10 questions out of 12	5
ii) Definition @ 1 mark for 5 questions out of 7	5
iii) Short notes @ 2½ marks for 2 questions out of three	5
iv) Essay type @ 5 marks for 1 question out of two	5
<b>Total</b>	<b><u>20</u></b>

- 7.5. If the student is not able to write the MSE due to his or her deputation by the University or due to other genuine reasons as judged by the Dean in consultation with Head of the Department and course teacher, he/she may be permitted to take up a make-up test of the particular examination. Such tests should be completed ordinarily within 15 working days after the respective MSE.

## 8. FINAL EXAMINATIONS

- 8.1. The final theory and practical examinations will be of three hours duration each.
- 8.2. Theory examinations will be conducted after practical examinations.
- 8.3. The question papers for the final theory examinations will be set by the external examiners.
- 8.4. Central valuation of answer books will be done by examiners on the advice of the Chairman, Board of Examiners.
- 8.5. Practical Examination  
Practical examinations will be conducted in the practical classes itself towards the end. Proper maintenance and regular submission of practical records are required. Those who do not bring with them the certified practical records/specimen collection / assignments will not be allowed to appear for the practical examination. The marks awarded for specimen collection and assignments shall be noted in the record, at the time of first appearance and will be taken into account for subsequent appearances. Such marks awarded by the examiner will be furnished to the Head of the Department.
- 8.6. Two examiners appointed by the University, of whom one will be the course teacher concerned and one teacher nominated by HOD will conduct the practical examination.

## 9. SUPPLEMENTARY EXAMINATION

- 9.1. A student who has failed in a course (subject) or awarded EE can take up supplementary examination without undergoing regular classes. A student who has not fulfilled attendance requirement should repeat the course to earn attendance before he/she is permitted to proceed to the next semester.
- 9.2. A candidate with OGPA of less than 5.50 shall be allowed to appear for the examination of the courses completed earlier in which he/she had obtained GPA of 6.00 or less.
- 9.3. Students with arrear subjects can reappear for the same at the time of regular semester examination only.
- 9.4. A continuing candidate cannot appear for more than six subjects in the supplementary examination at a time. The candidate who has completed the tenure of four years in the B.Sc. (Ag.) Degree Programme cannot appear for more than 16 subjects in the supplementary examination at a time.
- 9.5. a. There will be no supplementary examination for the courses viz., RAWE and Experiential learning. Those who fail in the above subject shall have to repeat the course in the subsequent year/ years.  
b. The supplementary *viva-voce* examination for these courses will be arranged as decided by the Dean for those who would have completed the course requirements but were unable to take up *viva-voce* due to medical or other compelling circumstances.

- 9.6. The candidates for the supplementary examinations will submit their applications through the Dean, Faculty of Agriculture who will scrutinize the applications to ensure compliance of regulation 9.2 and 9.4. The attested copy of all grade sheets pertaining to the supplementary examinations should be enclosed along with the applications.

## 10. ATTENDANCE REQUIREMENT

- 10.1 One hundred per cent class attendance is expected from each student. A student who fails to secure 75 per cent of attendance prescribed for a course (subject) of study, separately in theory and practical shall not be permitted to appear for both theory and practical examinations in that course (subject) and shall be given 'E' (incomplete) and will be required to repeat the course (subject).
- 10.2 Students abstaining from the classes by prior permission from the Dean, Faculty of Agriculture on Official University business, shall be given due consideration in computing attendance requirements. Such information should be forwarded to the course teacher within three working days.
- 10.3 However, condonation of attendance deficiency may be considered by the Vice-Chancellor only in case of genuine reasons including indoor hospitalization with evidence in the form of Hospitalization certificate and Discharge summary recommended by the Dean, Faculty. The Vice-Chancellor may decide whether or not a condonation fee is required, based on the reason for condonation fee.

## 11. EVALUATION

### 11.1. Final Grade Point Average

Based on the total credits offered, the final grade point average shall be calculated and given. The various courses taken by a student along with credits and the grades obtained shall be shown on his/her transcript.

- 11.2. At the end of each semester, the student will be given the grade card of the grades obtained along with the cumulative average of grades up to that semester by the University.

### 11.3. Calculation of OGPA

To arrive at the "Overall Grade Point Average (OGPA)" at the end of a semester, the grade point of each course is multiplied by the credit hours of the course to obtain the credit points. Then, the sum of the credit points secured by the student in all the courses taken till the end of that semester is divided by the total number of credit hours of the courses, provided that the credit hours and credit points of courses which are repeated are not counted more than once for this purpose.

#### For Example

- |  |                              |
|--|------------------------------|
| i. Total credit hours till the end of last semester      | : 18                         |
| ii. Total credit points till the end of last semester    | : 140.50                     |
| iii. Total credit hours in the current semester          | : 22                         |
| iv. Total credit points obtained in the current semester | : 156                        |
| v. Total credit hours including the current semester     | : $(18+22) = 40$             |
| vi. Total credit points including the current semester   | : $140.50 + 156.00 = 296.50$ |
| vii. Overall Grade Point Average                         | : $(296.50/40) = 7.412$      |
| viii. Corrected to two decimals                          | : $7.41 / 10.00$             |

- 11.4. The student should complete the requirements for getting B.Sc.( Ag.) degree, namely, OGPA of 5.5 out of 10.00 for all courses within a period of eight years from the date of his/her admission. If the candidate does not complete the requirements within the above said period he/she should seek readmission.

## 12. TUITION FEES AND SCHOLARSHIPS

The various fees payable by the students will be decided by the University from time to time.

- In case of new admission, the fees for the semester are payable in advance failing which they will not be admitted.
- In other cases, the fees are payable within seven working days from the commencement of the semester.
- In the case of default, a fine as per the University rules will be collected.
- The students who fail to pay the tuition fees within a month of commencement of the semester will not be allowed to attend the classes and their names will be struck off from the rolls. However, if the defaulting students pay the fees along with the fines in addition to a prescribed readmission fee, they will be permitted to attend the classes. The period for which his/her name is struck off from the rolls will be treated as absence for the purpose of calculating the minimum attendance requirements.

- e) Students who are away on study tour, camp activities or other extracurricular activities organised by the University or the Faculty at the commencement of the semester may, however, pay their semester tuition fees and other fees within the third working day after they return from such programmes, without fine.
- f) A student who has been granted scholarships by the Welfare Departments or by the Government of India or by the State Government will, however, be exempted from the levy of fines, provided the fees are paid on the next day after the scholarship amount is actually disbursed to him/her. The concession referred above will apply to those who have actually been granted scholarships and not to those who have only applied and are expecting sanction.
- g) The candidate should obtain a Hall Ticket from the Controller of Examinations through the Dean after clearing all arrears including the hostel dues before the commencement of each semester final examination.

### **13. TRANSITORY REGULATIONS**

Separate time table of course work under old semester system will be arranged by the H.D. for students with attendance deficiency in a course/courses provided such course/courses are not currently offered due to the introduction of the revised syllabi with effect from 2012 – 2013.

The candidates under old semester system will, however, complete all the examinations within a period of eight academic years from the year of admission.

## B.Sc. AGRICULTURE

### SEMESTER-WISE DISTRIBUTION OF COURSES (2012-2013)

#### SEMESTER – I

Sl. No.	Course No.	Course Title	Credit Hours		
			Theory	Practical	Total
1.	AGR 111	Principles of Agronomy and Agricultural Heritage	2	1	3
2.	AGR 112	Fundamentals of Agricultural Meteorology	1	1	2
3.	AGM 113	Agricultural Microbiology	2	1	3
4.	SAC 114	General Biochemistry	2	1	3
5.	GPB 115	Crop physiology	2	1	3
6.	HOR 116	Basic horticulture and plant propagation	1	1	2
7.	TAM / ENG 117	Tamil/English Development Education	0	1	1
8.	NSS/NCC 101*	National Service Scheme/ National Cadet Corps	0	1	1
<b>Total</b>			<b>10</b>	<b>8</b>	<b>18</b>

Note: \* The course on NSS / NCC has to be offered for four semesters I, II, III & IV

#### SEMESTER – II

Sl. No.	Course No.	Course Title	Credit Hours		
			Theory	Practical	Total
1.	AGR 121	Water Management	1	1	2
2.	ENT 122	Insect Morphology ,Systematics and Physiology	2	1	3
3.	PAT 123	Principles of Plant Pathology	2	1	3
4.	SAC 124	Introduction to Soil Science	2	1	3
5.	GPB 125	Genetics and Cytogenetics	2	1	3
6.	AEC 126	Principles of Agricultural Economics	1	1	2
7.	AEX 127	Fundamentals of Rural Sociology and Educational Psychology	2	0	2
8.	COM 128	Introduction to computer and application	1	1	2
9.	AEG 129	Farm Power and Machinery	1	1	2
<b>Total</b>			<b>14</b>	<b>8</b>	<b>22</b>

#### SEMESTER – III

Sl. No.	Course No.	Course Title	Credit Hours		
			Theory	Practical	Total
1.	AGR 211	Crop Production-I	0	1	1
2.	AGR 212	Agronomy of field Crops- I	2	1	3
3.	ENT 213	Beneficial Insects and Introductory Nematology	0	1	1
4.	SAC 214	Manures, Fertilizers and Agro-chemicals	2	1	3
5.	GPB 215	Principles and methods of Plant Breeding	2	1	3
6.	HOR 216	Production Technology of Fruit and plantation Crops	2	1	3
7.	AEC 217	Production Economics and Farm Management	1	1	2
8.	AEX 218	Dimensions of Agricultural Extension	1	1	2
9.	AHS 219	Livestock and Poultry Production	2	1	3
<b>Total</b>			<b>12</b>	<b>9</b>	<b>21</b>



**SEMESTER – IV**

Sl. No.	Course No.	Course Title	Credit Hours		
			Theory	Practical	Total
1.	AGR 221	Crop Production-II	0	1	1
2.	AGR 222	Agronomy of field crops- II	2	1	3
3.	PAT 223	Applied plant pathology	2	1	3
4.	GPB 224	Breeding of field and horticultural crops	2	1	3
5.	HOR 225	Production Technology of Vegetable and Flower crops	2	1	3
6.	AEC 226	Agricultural Marketing, Trade and Prices	1	1	2
7.	AEX 227	Extension Methodologies for Transfer of Agricultural Technology	1	1	2
8.	AEG 228	Fundamentals of Soil and Water Conservation Engineering	2	1	3
9.	STA 229	Statistics	1	1	2
		<b>Total</b>	<b>13</b>	<b>9</b>	<b>22</b>

**SEMESTER – V**

Sl. No.	Course No.	Course Title	Credit Hours		
			Theory	Practical	Total
1.	AEG 310	Renewable Energy	1	1	2
2.	AGR 311	Farming Systems and sustainable agriculture	1	1	2
3.	AGR 312	Post harvest Technology for Agricultural crops	1	1	2
4.	ENT 313	Insect Ecology, Integrated Pest Management and Insects of Ecological Importance	2	1	3
5.	PAT 314	Diseases of Field Crops	1	1	2
6.	GPB 315	Principles of Plant Biotechnology	2	1	3
7.	HOR 316	Production Technology of Spices, Aromatic, and Medicinal Crops	1	1	2
8.	AEC 317	Introduction to Agribusiness Management	1	1	2
9.	AEX 318	Entrepreneurship development	1	1	2
10.	ENG 319	Comprehension and communication skills in English	1	1	2
		<b>Total</b>	<b>12</b>	<b>10</b>	<b>22</b>

**SEMESTER – VI**

Sl. No.	Course No.	Course Title	Credit Hours		
			Theory	Practical	Total
1.	AGR 321	Weed Management	1	1	2
2.	AGR 322	Organic Farming	1	1	2
3.	ENT 323	Pests of Crops & Stored Produce and their Management	2	1	3
4.	PAT 324	Diseases of Horticultural crops and mushroom cultivation	2	1	3
5.	AGM 325	Environmental science	1	1	2
6.	SAC 326	Soil Chemistry, Soil Fertility and Nutrient Management	2	1	3
7.	GPB 327	Principles of Seed Technology	2	1	3
8.	HOR 328	Ornamental and landscape gardening	1	1	2
9.	AEC 329	Agricultural Finance, Banking and Co-Operation	1	1	2
		<b>Total</b>	<b>13</b>	<b>9</b>	<b>22</b>

## SEMESTER – VII

### Rural Agricultural Work Experience (RAWE)

S.No.	Course code	RAWE	Credit Hours
1.	RAE-411	<b>Crop Production</b> (Agronomy (0+2), Plant Breeding (0+1), Soil Science (0+1), Animal Husbandry(0+1))	0+5
2.	RAE-412	<b>Crop Protection</b> (Agronomy (0+1), Entomology (0+1), Plant Pathology (0+1), Micro Biology (0+1))	0+4
3.	RAE-413	<b>Extension Programme – Village stay programme – 6 weeks</b> (Agricultural Extension)	0+4
4.	RAE-414	<b>Rural Economics – Industrial attachment – 12 weeks</b> (Agricultural Economics)	0+7
<b>Total</b>			<b>0+20</b>

## SEMESTER – VIII

### Module I to VI I

Sl.No.	Course No.	Course Title	Credit Hours
1.		One module	8+5=13
2.		Experiential learning	0+5=5
<b>Total</b>			<b>8+10=18</b>

For eighth semester in experiential learning seven different modules have been evolved for options to be given for students. The module (I to VI) comprises three major courses of three credits each and two minor courses of two credits each. The module VII is comprised of the courses representing the major six areas as suggested by ICAR. Students choosing a module will complete 13 credits. The modules are as listed as follows.

#### Module I: Crop Production

(Department of Agronomy, Division of Animal Husbandry and Department of Horticulture)

S.No.	Course title	Credit hours
<b>Major</b>		
MEL 421	Design and Management of Farming Systems	2+1
MEL 422	Dry Farming and Water Shed Management	2+1
MEL 423	Forest Resource Management	2+1
<b>Minor</b>		
MEL 424	Invasive Alien Species and Bio-Diversity	1+1
MEL 425	Dairy and Poultry Products Technology	1+1

#### Module II: Commercial Entomology and Pathology

(Department of Plant Pathology and Entomology)

S.No.	Course title	Credit hours
<b>Major</b>		
MEL 426	Mass Multiplication and Application of Entomophages and Entomopathogens	2+1
MEL 427	Biological Control of plant diseases	2+1
MEL 428	Mushroom Cultivation	2+1
<b>Minor</b>		
MEL 429	Insects of Urban and Quarantine Importance	1+1
MEL 430	Natural Products in Insect Pest Management and their Formulation Techniques	1+1

#### Module III: Natural Resource Management

(Department of Soil Science and Agricultural Chemistry, Agricultural Microbiology and Agricultural Economics.)

S.No.	Course title	Credit hours
<b>Major</b>		
MEL 431	Remote sensing, GIS and Land Use Planning	2+1
MEL 432	Impact Assessment of Agrochemicals in Ecosystem	2+1
MEL 433	Soil Water Plant Health and Management	2+1

<b>Minor</b>		
MEL 434	Microbial and Environmental Biotechnology	1+1
MEL 435	Natural Resource Economics and Management	1+1

#### **Module IV: Crop Improvement**

(Department of Genetics and Plant Breeding, Horticulture and Microbiology)

<b>S.No.</b>	<b>Course title</b>	<b>Credit hours</b>
<b>Major</b>		
MEL 436	Molecular Plant Breeding	2+1
MEL 437	Plant Tissue Culture	2+1
MEL 438	Plant Genetic Resources	2+1
<b>Minor</b>		
MEL 439	Microbial and Environmental Technology	1+1
MEL 440	Growth and Development of Horticultural Crops	1+1

#### **Module V: Commercial Horticulture**

(Department of Horticulture, Agricultural Microbiology, Genetics and Plant Breeding)

<b>S.No.</b>	<b>Course title</b>	<b>Credit hours</b>
<b>Major</b>		
MEL 441	Nursery Management of Horticultural Crops	2+1
MEL 442	Protected Cultivation of Horticultural Crops	2+1
MEL 443	Post Harvest Technology of Horticultural Crops	2+1
<b>Minor</b>		
MEL 444	Microbial and Environment Technology	1+1
MEL 445	Seed Production of Horticultural Crops	1+1

#### **Module VI : Agri-Business Process Development**

(Department of Agricultural Economics and Department of Agricultural Extension)

<b>S.No.</b>	<b>Course title</b>	<b>Credit hours</b>
<b>Major</b>		
MEL 446	Project Formulation, Evaluation and Monitoring	2+1
MEL 447	Management of Agro-Based Industry	2+1
MEL 448	Cyber Extension	2+1
<b>Minor</b>		
MEL 449	Government Policies and Programmes Related to Agriculture	1+1
MEL 450	Video Production	1+1

This module will be taught by the

#### **Module VII** (All Departments)

<b>S.No.</b>	<b>Course title</b>	<b>Credit hours</b>	<b>Co- coordinating departments</b>
<b>Major</b>			
MEL 451	Climate Change and Bio-diversity Management	2+1	Agronomy & Animal husbandry
MEL 452	Agricultural Project Management	2+0	Agri. Economics & Agri. Extension
MEL 453	Emerging Trends in Insect Pests and Disease Management	1+1	Entomology & Plant Pathology
MEL 454	Germplasm Conservation	1+1	Genetics and Plant Breeding
MEL 455	Management of Commercial Orchards	1+1	Horticulture & Agri. Economics
MEL 456	Soil, Water, Plant Health and Management	1+1	SS&AC and Microbiology

**B.Sc. AGRICULTURE**  
**DISCIPLINE-WISE DISTRIBUTION OF COURSES (2012-2013)**

**I. AGRONOMY**

Sl. No.	Course No.	Course Title	Credit Hours		
			Theory	Practical	Total
1.	AGR 111	Principles of Agronomy and Agricultural Heritage	2	1	3
2.	AGR 112	Fundamentals of Agricultural Meteorology	1	1	2
3.	AGR 121	Water Management	1	1	2
4.	AGR 211	Crop Production-I	0	1	1
5.	AGR 212	Agronomy of field Crops- I	2	1	3
6.	AGR 221	Crop Production-II	0	1	1
7.	AGR 222	Agronomy of field Crops- II	2	1	3
8.	AGR 311	Farming System and sustainable agriculture	1	1	2
9.	AGR 312	Post harvest Technology for Agricultural crops	1	1	2
10.	AGR 321	Weed Management	1	1	2
11.	AGR 322	Organic Farming	1	1	2
<b>Total</b>			<b>12</b>	<b>11</b>	<b>23</b>

**II. ENTOMOLOGY**

Sl. No.	Course No.	Course Title	Credit Hours		
			Theory	Practical	Total
1.	ENT 122	Insect Morphology , Systematics and Physiology	2	1	3
2.	ENT 213	Beneficial Insects and Introductory Nematology	0	1	1
3.	ENT 313	Insect Ecology, Integrated Pest Management and Insects of Ecological Importance	2	1	3
4.	ENT 323	Pests of Crops & Stored Produce and their Management	2	1	3
<b>Total</b>			<b>6</b>	<b>4</b>	<b>10</b>

**III. PLANT PATHOLOGY**

Sl. No.	Course No.	Course Title	Credit Hours		
			Theory	Practical	Total
1.	PAT 123	Principles of Plant Pathology	2	1	3
2.	PAT 223	Applied plant pathology	2	1	3
3.	PAT 314	Diseases of Field Crops	1	1	2
4.	PAT 324	Diseases of Horticultural crops & mushroom cultivation	2	1	3
<b>Total</b>			<b>7</b>	<b>4</b>	<b>11</b>

**IV. AGRICULTURAL MICROBIOLOGY**

Sl. No.	Course No.	Course Title	Credit Hours		
			Theory	Practical	Total
1.	AGM 113	Agricultural Microbiology	2	1	3
2.	AGM 325	Environmental science	1	1	2
<b>Total</b>			<b>3</b>	<b>2</b>	<b>5</b>

**V. SOIL SCIENCE AND AGRICULTURAL CHEMISTRY**

Sl. No.	Course No.	Course Title	Credit Hours		
			Theory	Practical	Total
1.	SAC 114	General Biochemistry	2	1	3
2.	SAC 124	Introduction to Soil Science	2	1	3
3.	SAC 214	Manures, Fertilizers and Agro-chemicals	2	1	3
4.	SAC 326	Soil Chemistry, Soil Fertility and Nutrient Management	2	1	3
<b>Total</b>			<b>8</b>	<b>4</b>	<b>12</b>

**VI. GENETICS AND PLANT BREEDING**

Sl. No.	Course No.	Course Title	Credit Hours		
			Theory	Practical	Total
1.	GPB 115	Crop physiology	2	1	3
2.	GPB 125	Genetics and Cytogenetics	2	1	3
3.	GPB 215	Principles and methods of Plant Breeding	2	1	3
4.	GPB 224	Breeding of Field and Horticulture Crops	2	1	3
5.	GPB 315	Principles of Plant Biotechnology	2	1	3
6.	GPB 327	Principles of Seed Technology	2	1	3
		<b>Total</b>	<b>12</b>	<b>6</b>	<b>18</b>

**VII. HORTICULTURE**

Sl. No.	Course No.	Course Title	Credit Hours		
			Theory	Practical	Total
1.	HOR 116	Basic horticulture and plant propagation	1	1	2
2.	HOR 216	Production Technology of Fruit and plantation Crops	2	1	3
3.	HOR 225	Production Technology of Vegetable and Flower crops	2	1	3
4.	HOR 316	Production Technology of Spices, Aromatic, and Medicinal Crops	1	1	2
5.	HOR 328	Ornamental and landscape gardening	1	1	2
		<b>Total</b>	<b>7</b>	<b>5</b>	<b>12</b>

**VIII. AGRICULTURAL ECONOMICS**

Sl. No.	Course No.	Course Title	Credit Hours		
			Theory	Practical	Total
1.	AEC 126	Principles of Agricultural Economics	1	1	2
2.	AEC 217	Production Economics and Farm Management	1	1	2
3.	AEC 226	Agricultural Marketing, Trade and Prices	1	1	2
4.	AEC 317	Introduction to Agribusiness Management	1	1	2
5.	AEC 329	Agricultural Finance, Banking and Co-Operation	1	1	2
		<b>Total</b>	<b>5</b>	<b>5</b>	<b>10</b>

**IX. AGRICULTURAL EXTENSION**

Sl. No.	Course No.	Course Title	Credit Hours		
			Theory	Practical	Total
1.	AEX 127	Fundamentals of Rural Sociology and Educational Psychology	2	0	2
2.	AEX 218	Dimensions of Agricultural Extension	1	1	2
3.	AEX 227	Extension Methodologies for Transfer of Agricultural Technology	1	1	2
4.	AEX318	Entrepreneurship Development	1	1	2
		<b>Total</b>	<b>5</b>	<b>3</b>	<b>8</b>

**X. ANIMAL HUSBANDRY**

Sl. No.	Course No.	Course Title	Credit Hours		
			Theory	Practical	Total
1.	AHS 219	Livestock and Poultry Production	2	1	3
		<b>Total</b>	<b>2</b>	<b>1</b>	<b>3</b>

**XI. COURSES OFFERED BY OTHER DEPARTMENTS**

Sl. No.	Course No.	Course Title	Credit Hours		
			Theory	Practical	Total
<b>COMPUTER SCIENCE AND ENGINEERING</b>					
1.	COM 128	Introduction to computer and application	1	1	2
2.	AEG 129	Farm Power and Machinery	1	1	2
3.	AEG 228	Fundamentals of Soil and Water Conservation Engineering	2	1	3
4.	AEG 310	Renewable Energy	1	1	2
<b>STATISTICS</b>					
5.	STA 229	Statistics	1	1	2
<b>TAMIL / EDUCATION</b>					
6.	TAM 117	Tamil / Development of Education	0	1	1
<b>ENGLISH</b>					
7.	ENG 319	Comprehension and communication skills in English	1	1	2
<b>Total</b>			<b>7</b>	<b>7</b>	<b>14</b>

**XII. NSS / NCC**

Sl. No.	Course No.	Course Title	Credit Hours		
			Theory	Practical	Total
1.	101	NSS/NCC	0	1	1
<b>Total</b>			<b>0</b>	<b>1</b>	<b>1</b>

**SEMESTER- WISE CREDITS**

Semester	Number of courses	Credit Hours		
		Theory	Practicals	Total
I	8	10	8	18
II	9	14	8	22
III	9	12	9	21
IV	9	13	9	22
V	10	12	10	22
VI	9	13	9	22
VII	-	0	20	20
VIII	-	8	10	18
<b>Total</b>		<b>82</b>	<b>83</b>	<b>165</b>

## SEMESTER – I

### AGR 111: PRINCIPLES OF AGRONOMY AND AGRICULTURAL HERITAGE (2+1)

#### OBJECTIVES

Principles of Agronomy and Agricultural Heritage deals with practices of crop production and soil management. This course aims at exposure to the latest concepts of Agronomy on tillage, seeds and sowing, mineral nutrition, irrigation, soil conservation, dry land agriculture, weed management, nutrient management, farming systems, history of agriculture and agricultural development from ancient to modern age.

#### THEORY

##### Unit – I : Introduction to Agriculture

Agriculture – Definition – Importance and scope - Branches of agriculture - Agronomy – Definition – Meaning and scope - National and International Agricultural Research Institutes - Indian economy – National income – Role of women in agriculture.

##### Unit – II: History of Agriculture Development and Ancient civilization

History of agricultural development in World and India- Agriculture heritage – Agriculture in ancient India – - Evolution of man and agriculture – Development of scientific Agriculture. Stages of agriculture development - Era of civilization- Importance of Neolithic civilization - Chronological agricultural technology development in India- Kautilya's Arthasasthra- Sangam literature -Tamil Almanac and rainfall prediction.

##### Unit – III : Crop Distribution and Production

Agronomic classification of crops– Economic importance - Major crops of India and Tamil Nadu – Soils - Major soils of India and Tamil Nadu - Factors affecting crop production – climate - edaphic-biotic - physiographic and socio economic factors – seasons – Agriculture seasons of India & Tamilnadu.

##### Unit – IV: Basics of Agricultural operations and Weed management

Tillage – Definition - Types- Objectives - Modern concepts of tillage – Main field preparations - Seeds - Seed rate- Seed treatment- Nursery - sowing methods - Germination – Factors affecting germination - Crop stand establishment – Plant population and geometry - Effect on growth and yield - After cultivation – Thinning - Gap filling – Weeds – Definition – Beneficial and Harmful effects and its management– IWM.

##### Unit – V : Integrated nutrient management & Farming systems

Manures and fertilizers – Agronomic interventions for enhancing FUE–INM- Irrigation - Time and methods of irrigation - Modern techniques of irrigation - Drainage and its importance - Cropping patterns and cropping systems - intensive cropping - Crop rotation - Sustainable agriculture- integrated farming systems - Farm enterprises - Organic / eco-friendly agriculture - Concepts and principles – Dry farming- Concepts and principles .

#### PRACTICAL

Visit to college farm – Crop classification and identification of seeds; Identification and study of manures and fertilizers - working out seed rate - Study of seed treatment practices. Study of tillage implements (primary, secondary and special purpose)- Practice of methods of fertilizer applications and its calculations; Different methods of sowing; Study of seeding equipment's Study of inter-cultivation implements and practice - Participation in ongoing field operations.

#### THEORY - LECTURE SCHEDULE

1. Agriculture – Definition –Agriculture as Art, Science and Business
2. Importance and scope of agriculture in India and Tamilnadu
3. Branches of agriculture.
4. Agronomy – definition – meaning and scope
5. National and International Agricultural Research Institutes.
6. Indian agriculture- Indian economy – National income – per capita income – Agricultural income in GDP
7. Women in agriculture and empowerment.
8. History of agricultural development in the World and India
9. Agriculture heritage – Agriculture in ancient India and Evolution of man and agriculture
10. Development of scientific agriculture
11. Stages of agriculture development - Era of civilization
12. Importance of Neolithic civilization
13. Chronological agricultural technology development in India
14. Kautilya's Arthasasthra- Sangam literature
15. Prediction of Monsoon rains - Tamil Almanac.

16. Agronomic classification of crops
17. Economic and agricultural importance of crops in Tamil Nadu and India
18. **Mid-semester Examination**
19. Major crops of India and Tamil Nadu
20. Major soils of India and Tamil Nadu
21. Factors affecting crop production – climatic – edaphic - biotic- physiographic and socio economic factors
22. Tillage – Definition – objectives -Types of tillage
23. Modern concepts of tillage – main field preparation
24. Seeds - Seed rate – Seed treatment- Different methods of sowing
25. Germination –Factors affecting germination
26. Crop stand establishment – Plant Population & geometry
27. Inter cultivation - Thinning - gap filling and other intercultural operations
28. Weeds – Definition –beneficial and harmful effects of weeds
29. Crop weed competition and management of weeds – IWM
30. Role of manures and fertilizers in crop production – agronomic interventions for enhancing FUE – INM
31. Irrigation - time and methods - Modern techniques of irrigation -.Drainage and its importance.
32. Cropping patterns and cropping system - intensive cropping- sustainable agriculture – IFS
33. Organic agriculture – Natural farming -Dry farming- concepts and principles

### **PRACTICAL SCHEDULE**

1. Visit to college farm to observe wetland farming system, garden land and dry land farming systems
2. Identification of crops and seeds
3. Identification of manures and fertilizers
4. Identification of agrochemicals and their usage
5. Identification of green manures and green leaf manures
6. Identification of tools and implements
7. Acquiring skill in handling primary and secondary tillage implements
8. Study of labour saving and special purpose implements
9. Seed treatment techniques -Nursery preparation
10. Study on different methods of sowing and seeding implements
11. Methods of application of manures and fertilizers
12. Observing various irrigation methods and herbicide application methods
13. Working out seed rate
14. Practicing thinning, gap filling operations for optimum crop stand and intercultural operations
15. Calculation on plant population and geometry
16. Working out fertilizer requirement of crops

### **17. Practical Examination**

### **REFERENCES**

1. Balsubramanian, P. and SP.Palaniappan, 2010. Principles and Practices of Agronomy. Agrobios. Jodhpur - 342 002.
2. Chandrasekaran, B., K. Annadurai and E. Somasundaram. 2010. A Textbook of Agronomy. New Age International Publishers, New Delhi.
3. ICAR. 1996. Handbook of Agriculture. Indian Council of Agricultural Research, New Delhi.
4. Panda, S.C. 2010. Agronomy. Agro bios (India), Jodhpur - 342 002.
5. Yellamananda Reddy, T. and G.H. Sankara Reddi 2003. Principles of Agronomy. Kalyani Publishers, New Delhi.



## AGR 112: FUNDAMENTALS OF AGRICULTURAL METEOROLOGY (1+1)

### OBJECTIVES

This course is scheduled to study the problems of plant growth and yield in relation to environmental factors. Climatic factors alone affect the yield of crops to an extent of about 40%. In India the success of agriculture depends mainly on monsoon rains. Agricultural Meteorology is mainly concerned with microclimatology in which the influence of the shallow layer of atmosphere immediately above the surface is studied.

### THEORY

#### Unit I: Introduction to Agricultural Meteorology

Meteorology - Agricultural Meteorology - Importance and scope in crop production - Coordinates of India and Tamil Nadu - Atmosphere - Composition and vertical layers of atmosphere (stratification) - Climate - Weather - Factors affecting climate and weather - Climatic types - Different agricultural seasons of India and Tamil Nadu – Agro-climatic regions of India and Tamil Nadu.

#### Unit II: Solar radiation and temperature

Solar radiation - Light intensity, quality, direction and duration - Air and Soil temperature - Diurnal variation - importance in crop production- Heat unit and its importance in agriculture. Relative Humidity and its importance – vapour pressure deficit and its importance - Wind and its effect on crops.

#### Unit III : Atmospheric pressure, Rainfall and Wind systems of the World

Atmospheric pressure - Pressure systems - cyclones, anticyclones, tornado, hurricane and storms - Wind systems of the world - Inter Tropical Convergence Zone. Clouds - types and their classification. Precipitation - forms - monsoon - - Seasons of India- rainfall variability drought, flood and their effect - Cloud seeding – Evapotranspiration – transpiration - PET

#### Unit IV: Agro climatic zones and Forecasting

Agro climatic Zones – Agro climatic normals - Weather forecasting –importance, synoptic chart - crop weather calendar - Remote sensing and crop weather modeling - Impact of climate and weather on crop production and pest and diseases.

#### Unit V: Climate change and it's impact

Climate change- climate variability – definition and causes of climate change - Impact of climate change on Agriculture, Forestry, Hydrology, marine and coastal ecosystem.

### PRACTICAL

Agromet Observatory - Site selection and layout. Acquiring skill in the use of different instruments and recording data on rainfall, temperature, pressure, humidity, wind direction and velocity, solar radiation, sunshine hours, evaporation, evapotranspiration, Lysimeters - Automatic weather station - Preparation of synoptic charts and crop weather calendars -Mapping of Agro climatic Zones.

### THEORY LECTURE SCHEDULE

1. Meteorology - Agricultural Meteorology - Definition, their importance and scope in crop production.
2. Coordinates of India and Tamil Nadu. Atmosphere - Composition of atmosphere - Vertical layers of atmosphere based on temperature difference / lapse rate.
3. Climate and weather - Factors affecting climate and weather. Macroclimate - Mesoclimate - Microclimate - Definition and their importance - Different climates of India and Tamil Nadu and their characterization.
4. Solar radiation - Radiation balance - Wave length characteristics and their effect on crop production - Light – effect of intensity, quality, direction and duration on crop production.
5. Air temperature - Factors affecting temperature. Diurnal and seasonal variation in air temperature – Isotherm, Heat unit and its use - Heat and cold injuries.
6. Role of temperature in crop production. Soil temperature - Importance in crop production. Factors affecting soil temperature, diurnal and seasonal variation in soil temperature.
7. Humidity – Types - Dew point temperature - Vapour pressure deficit - Diurnal variation in Relative humidity and its effect on crop production – Wind and its role on crop production.
8. Atmospheric pressure, diurnal and seasonal variation - Pressure systems of the world - causes for variation - Isobar - Low, depression, anticyclone, Tornado, hurricane.
9. **Mid Semester Examination**
10. Wind systems of the world - Inter Tropical Convergence Zones (ITCZ), wind speed in different seasons -. Clouds and their classification - Concepts of cloud seeding – present status.
11. Precipitation - Forms of precipitation - Isohyet - Monsoon – Different monsoons of India - Rainfall variability - Drought and flood – Impact on crop production.
12. Evaporation - Transpiration, evapotranspiration - Potential evapotranspiration - Definition and their importance in agricultural production. Agro climatic zones of Tamil Nadu - Agro climatic normals for field crops.

13. Weather forecasting - Types, importance, Agro Advisory Services - Synoptic chart - Crop weather calendar.
14. Remote sensing and its application in agriculture – Crop weather modeling and its application in agriculture – list of models available.
15. Effect of weather and climate on crop production, soil fertility and incidence of pest and diseases.
16. Climate change, climate variability – definition and causes of climate change including ENSO.
17. Impact of climate change on Agriculture, Forestry, Hydrology, marine and coastal ecosystem.

### **PRACTICAL SCHEDULE**

1. Site selection and layout for Agromet Observatory - Calculation of local time - Time of observation of different weather elements.
2. An introduction to Annamalai University Meteorological Observatory
3. Measurement of air and soil temperature and grass minimum thermometers and thermographs
4. Measurement of solar radiation and sunshine hours
5. Humidity measurements – use of wet and dry bulb, assmann psychrometer
6. Measurement of wind direction and wind speed – Beaufort’s scale.
7. Measurement of rainfall - Ordinary and self-recording rain gauges
8. Measurement of Dew - dew gauge.
9. Measurement of atmospheric pressure - barograph
10. Measurement of Evaporation - Open pan evaporimeter- application of evaporation data- Measurement of Evapotranspiration- Lysimeter.
11. Study of Automatic weather station
12. Data analysis for rainfall chart and thermo hygrograph chart data
13. Analysis of weather data
14. Preparation of crop weather calendars and forecast based on agro advisories
15. Preparation of Synoptic charts.
16. Mapping of agro climatic Zones of India and Tamil Nadu and its characterization.
17. **Practical Examination.**

### **REFERENCES**

1. Ghadekar, S.R. 2008. Text book on Agro meteorology. Agromet Publishers, Nagpur.
2. Nanjappa and Ramachandrappa. 2007. Manual on Practical Agricultural Meteorology. Agrobios (India), Jodhpur.
3. Panda S.C. 2010. Agro meteorology and contingent crop planning. Agrobios (India), Jodhpur.
4. Prasad, Rao, G.S.L.H.V. 2005. Agricultural Meteorology. Kerala Agricultural University, Press, Thrissur.

## AGM 113: AGRICULTURAL MICROBIOLOGY (2+1)

### OBJECTIVES

To study the fundamental principles, microbial transformations of C, N, P and applied aspects of microorganisms.

### THEORY

#### Unit - I: History and scope of Microbiology

Contributions of Anton Van Leeuwenhoek, Louis Pasteur, John Tyndall, Robert Koch, Edward Jenner, Joseph Lister, Beijerinck, Winogradsky and Waksman; Position of microorganisms in living world; Prokaryotes Vs Eukaryotes; Groups of microorganisms; Bacterial size, shape and arrangement and morphology; functional anatomy of bacteria; Structure and organization of bacterial cell: Invariant and variant components, Structure and organization of microbial cells.

#### Unit-II: Microbiological Techniques

Microscopy – principles and types; Staining of microorganisms – principles; Sterilization and disinfection techniques; Principles and methods of sterilization – Physical methods – heat, filters and radiation; Chemical methods; Isolation and pure culture techniques – Enrichment culturing, dilution – plating, streak plate, spread plate methods; Preservation of microbial cultures.

#### Unit-III: Microbial Physiology and Genetics

Bacterial growth, reproduction and factors influencing bacterial growth – Growth curve; Nutritional types and metabolic diversity of bacteria; Principles of energy generation and carbon metabolism; fermentation – respiration in bacteria. Genetic Recombination –Transformation, Conjugation and Transduction.

#### Unit-IV: Soil Microbiology

Distribution and importance of soil microorganisms in soil fertility – factors affecting the activities of soil microorganisms; Rhizosphere microorganisms and their importance, R:S Ratio; Phyllosphere microorganisms – Plant – microbe and Microbe – microbe interactions in soil.

#### Unit-V: Microbial transformation of nutrients in soil

Microbial transformation of nutrients in soil – Carbon, Phosphorous and Sulphur cycle; Nitrogen cycle, Biological Nitrogen fixation – Symbiotic and non-symbiotic nitrogen fixing microorganisms, Process of nodulation and nitrogen fixation; Silicate and Zinc solubilizing bacteria – Types and importance of biofertilizers in Agriculture; Mass production and quality control of biofertilizers.

### PRACTICAL

Microscopy – Light microscopes; Staining Techniques – Simple and Differential staining; Sterilization – equipment and apparatus used for sterilization; Media preparation; Isolation and enumeration of soil microorganisms; Purification and preservation of microorganisms; morphological and biochemical characters of bacteria.

Quality analysis of soil microbial profile – Organic matter decomposition – measurement of CO<sub>2</sub> evolution; Isolation of N<sub>2</sub> fixing and Phosphate solubilizing microorganisms; Infection by Arbuscular mycorrhizae; Winogradsky column – Mass production of bacterial biofertilizers – Mass production of algal and fungal biofertilizers; Demonstration of antibiosis.

### THEORY SCHEDULE

1. Definition and scope of microbiology –Spontaneous generation theory.
2. Contributions of Anton Van Leeuwenhoek, Louis Pasteur, John Tyndall, Robert Koch, Edward Jenner, Joseph Lister, Beijerinck, Winogradsky and Waksman – Germ theory of fermentation and disease.
3. Position of microorganisms in living world; Prokaryotes Vs Eukaryotes.
4. Bacterial morphology – arrangement of cells, structures.
5. Functional anatomy and reproduction in bacteria.
6. Morphology of fungi and economic importance.
7. Morphology of algae and their economic importance.
8. Microscopy: principles – different types of microscopy.
9. Microbial staining – principles – simple staining and differential staining.
10. Sterilization- principles – physical and chemical methods.
11. Bacterial growth – Growth curve – generation time and growth rate.
12. Environmental conditions for growth – Temperature – Psychrophiles, Mesophiles and Thermophiles; air – aerobic and anaerobic; pH – acidic and alkali; salt.
13. Nutritional types of bacteria – autotrophs, heterotrophs, phototrophs and chemolithotrophs.
14. Microbial metabolism – principles of energy generation – Phosphorylation.
15. Respiration – fermentation.
16. Genetic Recombination – Transformation, Conjugation.
17. Outline classification of bacteria – Bergey's Manual of Systematic Bacteriology, Edn.II

### 18. Mid semester examination

19. Overview of Soil Microbiology – Definition, concepts and scope of soil microbiology – Discoveries in soil microbiology.
20. Diversity of soil microorganisms – bacteria, Actinomycetes, fungi and algae – factors influencing the microbial diversity.
21. Factors affecting the activities of soil microorganisms.
22. Rhizosphere Microorganisms – R:S ratio and importance.
23. Plant growth promoting rhizobacteria; Phyllosphere Microbiology and Methylophs.
24. Microbial interaction in soil – neutralism, positive and negative interactions.
25. Microbial transformation of nutrients in soil – Carbon cycle.
26. Organic matter decomposition – aerobic and anaerobic – Importance of C:N ratio in soil fertility – humus formation.
27. Microbial transformation of nutrients in soil – Nitrogen.
28. Biological nitrogen fixation – symbiotic and non-symbiotic microorganisms.
29. Process and genetics of nodulation and nitrogen fixation.
30. Microbial transformation of nutrients in soil – Phosphorous & Sulphur.
31. Silicate and Zinc solubilizing microorganisms; Mycorrhizae.
32. Types of biofertilizers and importance in agriculture.
33. Production and quality control of biofertilizers
34. Methods of application of biofertilizers.

### PRACTICAL SCHEDULE

1. Microscopes – Handling light microscope.
2. Staining techniques – Simple and Differential staining.
3. Sterilization – equipment and apparatus used for sterilization.
4. Media preparation for bacteria, fungi and Actinomycetes.
5. Enumeration of soil microorganisms – serial dilution plate technique (bacteria, fungi and actinomycetes).
6. Purification and preservation of bacteria and fungi.
7. Growth of bacteria – Turbidimetric method.
8. Morphology and biochemical characters of bacteria.
9. Conn's direct microscopic count and Burried slide technique.
10. Organic matter decomposition - measurement of CO<sub>2</sub> evolution
11. Demonstration of antibiosis – crowded plate assay.
12. Isolation of symbiotic N<sub>2</sub> fixing microorganisms – *Rhizobium*.
13. Isolation of associative and non-symbiotic N<sub>2</sub> fixer: *Azospirillum* and *Azotobacter*.
14. Isolation of phosphate solubilizing microorganisms and demonstration of Winogradsky column.
15. Assessment of AM fungi colonization in crop plants.
16. Mass production of biofertilizers.

### 17. Final Practical Examination

### REFERENCES

1. Black, J.G. 2005. Microbiology: Principles and Explorations, John Wiley, USA.
2. Michael Madigan, John Martinko and Jack Parker. 2006. Brock Biology of Microorganisms. 11<sup>th</sup> Edition. Benjamin Cummings, England.
3. Prescott, M.J., Harley, J.P. and Klein, D.A. 2002. Microbiology. 5<sup>th</sup> Edition, WBC Mc Graw Hill, New York.
4. Singh, T. Purohit, S.S. and Parihar, P. Soil Microbiology. 2010. Agrobios, India.
5. Subba Rao, N.S. 2006. Soil Microbiology (4<sup>th</sup> Edition of Soil Microbiology and Plant Growth). Oxford & IBH, New Delhi.

## SAC 114 GENERAL BIOCHEMISTRY (2+1)

### OBJECTIVE:

To impart knowledge on the fundamentals of Biochemistry. The students will get a clear idea of the basic concepts of biochemistry in general and will have an overall view of the different biochemical reactions taking place in plant cells. At the end of the course the students will have a conceptual understanding of the structure of biomolecules, separation of biomolecules using various biochemical techniques and qualitative identification and quantitative estimation of compounds.

### THEORY

#### Unit I: Bio molecules and Proteins, Nature and properties

Introduction to Biochemistry-importance and scope .Plant cell – various organelles and their functions; role of plant cell wall in livestock, food and paper industry.Biomolecules –structure, properties and applications.Proteins – amino acids – classification — reactions of amino acids.Peptides and their functions – Structure of proteins – Properties - Classification of proteins based on function – plant protein quality

#### Unit II: Enzymes and metabolism of carbohydrates

Enzymes – characteristics - factors affecting enzyme activity – enzymeinhibition –Enzyme Classification – immobilization and industrial applications of enzymes.Lipids – classification – functions and properties - Acyl lipids and their industrial applications. Carbohydrates – functions – structure and classification- Role in industry

#### Unit III: Metabolism of proteins

Nucleic acids – functions – structure - Various types of DNAs and RNAs – packing of DNA into chromosomes. Metabolism – anabolism – catabolism – stages of respiration – over all metabolicview of carbohydrates, proteins and lipids. Protein metabolism – central dogma – genetic code – ribosomes – ribozymes –tRNA – translation – enzymatic hydrolysis of protein – general reactions of amino acid metabolism – Assimilation of ammonia – entry of carbon skeleton into various metabolic pathways

#### Unit IV : Metabolism of lipids

Metabolism of lipids – anabolism of saturated &unsaturated fatty acidsand triacylglycerols-Catabolism of lipids –  $\alpha$  and  $\beta$  oxidation of fatty acids – glyoxylic acid cycle.Metabolism of carbohydrates – anabolism – photosynthesis.catabolism –hydrolysis of starch.Glycolysis and Tricarboxylic Acid (TCA) cycle. Oxidative pentose phosphate pathway - Oxidative **phosphorylation** – electron transportchain – metabolic regulation

#### Unit V : Secondary metabolites

Secondary metabolites – terpenoids – chemical nature – classification and applicationin food and pharmaceuticalindustry.Secondary metabolites – alkaloids – chemical nature – classification and applicationin food and pharmaceuticalindustry. Secondary metabolites – phenolics – chemical nature–classification and application in food and pharmaceuticalindustry

### PRACTICAL

Atomic models and reactions of Amino acids; Paper electrophoresis for the separation of plantpigments; Protein denaturation – heat, pH, precipitation of proteins with heavy metals,Protein estimation by Lowry method; Enzyme kinetics, competitive inhibition, enzymeimmobilization; Extraction of nucleic acids, column chromatography of RNA hydrolysate;Characterization of lipids by Thin Layer Chromatography.; Extraction of oil from oil seeds; Estimation of fattyacids ; Models of sugars, sucrose & starch; Quantitative determination of sugars;Paper chromatography for the separation of sugars; Determination of phenols.

### THEORY LECTURE SCHEDULE

1. Introduction – importance and scope of biochemistry
2. Plant cell – organelles in plant cell and their functions; Biomolecules –structure, properties and applications
3. Components of plant cell wall – primary and secondary cell wall – compositionand functions – role of plant cell wall in livestock, food and paper industry
4. Proteins – amino acids – classification – protein and non protein amino acids, essentialand non essential amino acids – classification based on their hydrophobicity of R(side chain) groups – reactions of amino acids like Ninhydrin reaction and peptidebond formation
5. Peptides and their functions – oligopeptides – cyclic and acyclic peptides – hormones – insulin
6. Structure of proteins – primary, secondary, tertiary and quaternary structures
7. Properties of proteins – Ultraviolet (UV) absorption – isoelectric point – zwitterions –immunological properties – denaturation – molecular chaperons – solubility – factorsinfluencing solubility

8. Sequencing of amino acids by Edman degradation method – purification techniques– salting in and salting out, gel filtration, ion exchange chromatography
9. Classification of proteins based on function – plant protein quality evaluation methods - Protein Efficiency Ratio (PER), Digestibility Coefficient (DC) and Biological Value (BV)
10. Enzymes – characteristics of enzymes – chemical nature, speed, specificity, active site and mode of action – activation energy and change in free energy of enzyme catalyzed reaction
11. Measurement of enzyme activity – factors affecting enzyme activity – enzyme inhibition – isoenzymes – multienzyme complexes – allosteric enzymes and coenzymes
12. Classification of enzymes – industrial applications of enzymes
13. Lipids – classification – functions and properties – Fat constants
14. Acyl lipids and their industrial applications in soaps, detergents, paints, rubber, bio-diesel etc.
15. Carbohydrates – functions – structure and classification
16. Role of mono, oligo and polysaccharides in industry
17. Nucleic acids – functions – structure of nitrogen bases – nucleosides and nucleotides – secondary structure of DNA
18. Mid Semester Examination
19. Various types of DNAs and RNAs – packing of DNA into chromosomes
20. Metabolism – anabolism – catabolism – stages of respiration – over all metabolic view of carbohydrates, proteins and lipids
21. Protein metabolism – central dogma – genetic code – ribosomes – ribozymes – tRNA – translation and its inhibitors
22. Post translational modification – enzymatic hydrolysis of protein – general reactions of amino acid metabolism – decarboxylation, transamination and deamination
23. Assimilation of ammonia – entry of carbon skeleton into various metabolic pathways
24. Metabolism of lipids – anabolism of saturated fatty acids, unsaturated fatty acids and triacylglycerols
25. Catabolism of lipids – triacylglycerols –  $\alpha$  and  $\beta$  oxidation of fatty acids – glyoxylic acid cycle
26. Metabolism of carbohydrates – anabolism – photosynthesis in brief; catabolism – hydrolysis of starch
27. Glycolysis and Tricarboxylic Acid (TCA) cycle
28. Oxidative pentose phosphate pathway – metabolic energy generation in different cycles
29. Oxidative phosphorylation and substrate level phosphorylation – electron transport chain in mitochondria
30. Electron transport chain in chloroplast – metabolic regulation
31. Secondary metabolites – terpenoids – chemical nature – classification and application in food and pharmaceutical industry
32. Secondary metabolites – alkaloids – chemical nature – classification and application in food and pharmaceutical industry
33. Secondary metabolites – phenolics (lignins, tannins and flavonoids) – chemical nature-
34. Classification and application in food and pharmaceutical industry

### **PRACTICAL CLASS SCHEDULE**

1. Atomic models of amino acids
2. Reactions of amino acids
3. Protein denaturation – heat, pH – precipitation of proteins heavy metals, organic solvents and acidic agents – immune reaction
4. Paper electrophoresis for separation of plant pigments
5. Paper model of protein – protein estimation by Lowry method
6. Enzyme kinetics (graphical representation) – competitive inhibition
7. Enzyme immobilization – enzyme induction
8. Extraction of DNA – test for DNA
9. Column chromatography of RNA hydrolysate
10. Fatty acid model – characterization of lipids by Thin Layer Chromatography (TLC)
11. Extraction of oil from oil seeds
12. Estimation of fatty acids by Gas Chromatography (GC)
13. Atomic models of sugars – paper model of starch
14. Quantitative determination of sugars
15. Separation of sugars and amino acids by paper chromatography
16. Determination of phenols
17. Practical Examination

### **REFERENCES**

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2. Jayaraman, J. 1980. *Laboratory Manual in Biochemistry*. Wiley Eastern Publishers, New Delhi.

3. Lehninger, A.L., Nelson, D.A. and Cox, M.M. 2005. *Principles of Biochemistry*. CBS Publishers and Distributors, New Delhi.
4. Rameshwar, A. 2006. *Practical Biochemistry*. Kalyani Publishers, Ludhiana.
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## **GPB 115: CROP PHYSIOLOGY (2+1)**

### **OBJECTIVE**

- \* To understand the mechanism of absorption and translocation of water and nutrients from the soil
- \* To study the different pathways in photosynthesis and respiration
- \* To study the topics on plant growth regulators and stress physiology.

### **THEORY**

#### **Unit I: Plant Water Relations**

Importance of Crop Physiology in Agriculture, Role of water – Water potential and components - Definitions - field capacity, water holding capacity of soil and permanent wilting point, Absorption and translocation of water and solutes, Transpiration - significance- antitranspirants.

#### **Unit II: Nutrient Physiology**

Mineral nutrition – mobility and Mechanism of uptake - physiological role of nutrients, Physiological disorders - nutritional disorders (deficiencies and toxicities) - Difference between Physiological and nutritional disorders - diagnosis, identification of disorders - foliar, tissue testing. Management Techniques- foliar feeding, root feeding, trunk feeding and fertigation.

#### **Unit III: Carbon Fixation**

Photosynthesis - light reaction and Photosynthetic pathways - C<sub>3</sub>, C<sub>4</sub> and CAM - Differences between C<sub>3</sub>, C<sub>4</sub> and CAM pathways - Factors affecting photosynthesis, Photorespiration and significance Phloem and xylem loading- Source sink relationship.

#### **Unit IV: Growth Physiology**

Growth - Growth analysis - LAI, LAD, SLW, SLA, LAR, NAR, RGR and CGR in relation to crop productivity, - Photoperiodism - Role of phytochrome in flowering and regulation of flowering. Vernalisation – de-vernalisation- Plant growth regulators and commercial applications - physiological role of auxins and GA Physiological role of Cytokinin, Ethylene and ABA - novel growth regulators and retardants their uses in crop productivity, Post harvest Physiology - Physiology of seed germination, seed and bud dormancy and breaking methods, Parthenocarpy - Physiology of fruit ripening - climacteric and non-climacteric fruits- factors affecting ripening and storage, Abscission – senescence, Shelf life and quality changes – use of PGRs and nutrients.

#### **Unit V: Stress Physiology**

Environmental stresses - water stress - physiological changes - adaptation to drought and its amelioration, Temperature stress - Physiological changes - low and high temperature - chilling injury - tolerance – alleviation, Low light and UV radiation stresses - salt stress - physiological changes and alleviation, Global warming – Carbon Sequestration - physiological effects on crop productivity,

### **PRACTICAL**

Measurement of plant water status by different methods - Estimation of stomatal index and stomatal frequency - Measurement of leaf area by different methods - Physiological and Nutritional disorders in crops plants - Rapid Tissue Tests - Estimation of chlorophyll Stability Index - Estimation of RWC - Determination of photosynthetic efficiency in crop plants - Estimation of Nitrate reductase activity - Growth Analysis - Determination of LAI, LAD, SLA, SLW, LAR, NAR, RGR, CGR and HI - Bioassay of cytokinin and GA - Estimation of proline accumulation to assess the water stress in crop plants - Demonstration of crop response to growth regulators - Field visit for foliar diagnosis.

### **THEORY SCHEDULE**

1. Importance of Crop Physiology in Agriculture.
2. Role of water – process and significance
3. Definition - field capacity, water holding capacity of soil and permanent wilting point.
4. Translocation of water and solutes - phloem and xylem transport.
5. Transpiration - mechanism – significance - guttation - antitranspirants.
6. Mineral nutrition - macro, secondary and micronutrients - sand, hydroponics and aeroponic culture .

7. Mechanism of uptake - physiological role of nutrients.
8. Foliar diagnosis - nutritional and physiological disorders
9. Foliar nutrition- root feeding, trunk feeding and fertigation
10. Photosynthesis - light reaction
11. Photosynthetic pathways - C<sub>3</sub>, C<sub>4</sub> and CAM
12. Differences between C<sub>3</sub>, C<sub>4</sub> and CAM pathways - Factors affecting photosynthesis.
13. Photorespiration - photorespiration process and significance of photorespiration.
14. Source sink relationship and their manipulations
15. Photoperiodism - short day, long day and day neutral plants.
16. Phytochrome. Role of phytochrome in flowering and regulation of flowering.
- 17. Mid Semester Examination**
18. Vernalisation - mechanism of vernalisation and its significance - devernalisation.
19. Growth analysis - LAI, LAD, SLW, SLA, LAR, NAR, RGR and CGR in relation to crop productivity.
20. Plant growth regulators - Physiological role of Auxins and GA.
21. Physiological role of Cytokinin, and ABA
22. Physiological role of Ethylene
23. Novel growth regulators and retardants and their uses in crop productivity.
24. Seed germination - physiological changes, seed and bud dormancy, breaking methods
25. Abscission - senescence
26. Physiology of ripening- climatic, non climatic and factors affecting ripening and storage
27. Role of PGRS and nutrients in shelf life and quality changes
28. Environmental stresses - water stress - physiological changes - adaptation and amelioration.
29. Temperature stress - Physiological changes - low and high temperature – adaptation and amelioration
30. Chilling injury - tolerance - alleviation.
31. Low light and UV radiation stresses – physiological changes - adaptation and amelioration.
32. Salt stress - physiological changes- adaptation and alleviation
33. Global warming – physiological effects of green house gases
34. Carbon Sequestration - physiological effects on crop productivity

### **PRACTICAL SCHEDULE**

1. Preparation of solutions
2. Measurement of plant water status by different methods.
3. Estimation of stomatal index and stomatal frequency.
4. Measurement of leaf area by different methods.
5. Physiological and Nutritional disorders in crops plants
6. Rapid Tissue Tests
7. Estimation of chlorophyll Stability Index
8. Estimation of RWC
9. Determination of photosynthetic efficiency in crop plants.
10. Estimation of Nitrate reductase activity
11. Growth Analysis - Determination of LAI, LAD, SLA, SLW, LAR, NAR, RGR, CGR and HI.
12. Bioassay of cytokinin
13. Bioassay of GA
14. Estimation of proline accumulation to assess the water stress in crop plants.
15. Demonstration of crop response to growth regulators.
16. Field visit for foliar diagnosis.
- 17. Final Practical Examination**

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1. Jain, J.K. 2007. Fundamentals of plant physiology, S.Chand & Company Ltd., New Delhi.
2. Pandey, S. N. and B. K.Sinha, 2006. Plant Physiology. Vikas Publishing House Private Limited, New Delhi.
3. Purohit, S.S, 2005. Plant physiology, Agrobios, Jodhpur.
4. Ray Noggle, G. and Fritz, G. J., 1991. Introductory Plant Physiology. Prentice Hall of India Pvt. Ltd., New Delhi.
5. Taiz. L. and Zeiger. E., 2006. Plant Physiology. Sinauer Associates, Inc., Massachusetts, USA.



## HOR 116: BASIC HORTICULTURE AND PLANT PROPAGATION (1+ 1)

### OBJECTIVES

This course will expose the basic and fundamentals aspects of Horticulture including propagation methods, planting systems, training, pruning, orchard layout, growth regulation, and components of protected cultivation.

### THEORY

#### Unit I Basic concepts of horticulture

Horticulture – origin, definition, Scope and importance – Global scenario of horticultural crops- Divisions of horticulture - area and production – export and import – Special features of Horticultural crops grown in India classification of horticultural crops – Nutritive value of horticultural crops Horticulture Zones of India and Tamil Nadu – Horticultural developmental agencies.

#### Unit II: Propagation techniques

Propagation – definition – methods- seed propagation – merits and demerits – Propagation through seeds - dormancy and methods of overcoming dormancy – vegetative propagation – merits and demerits – cutting, layering, grafting and budding – rootstock influence – stock / scion relationship- - Specialized plant parts– micro propagation- clonal orchards.

#### Unit III: Factors of Horticultural Crop Production

Factors limiting growth and development – climate and soil - light, temperature, wind, humidity, rainfall and frost – soil factors - soil fertility management - physiology of flowering, pollination, fruit set, fruit ripening and senescence – Fruitfulness and causes of unfruitfulness – Growth regulators and growth hormones – Classification and applications.

#### Unit IV: Cropping systems

Cropping systems - intercropping - multi-tier cropping - planting methods –Crop geometry- intercultural operations – weed, water and fertilizer management – bearing habits – crop regulatory practices for fruit crops and vegetables – training, pruning, and special practices - off season production – rejuvenation of old and senile orchards.

#### Unit V Protected cultivation and post harvest handling

Basics of protected cultivation- Green house, glass house, Mist chamber- hydroponics -principles of organic horticulture –Pre-harvest operations – maturity indices – climacteric and non-climacteric fruits - harvesting methods - harvesting and post harvest handling – processing, value addition, storage and marketing of horticultural produce.

### PRACTICAL

Features of an orchard – Tools, implements and machineries used for horticultural operations – raising seedlings and rootstocks – preparation of pot mixture, potting and repotting of plants – propagation structures, mist chamber shade net, glass houses and poly houses – their operations and maintenance – preparation and application of PGR's for propagation and crop regulation- methods of propagation – cutting, grafting, layering and budding –specialized plant parts for propagation–rejuvenation – micro propagation, protocol for mass multiplication and hardening – planning and layout of orchard and planting – methods of manuring and irrigation – bearing habits – training, pruning and special practices – maturity standards –packing materials and techniques – visit to commercial orchards and nurseries- planning, layout and maintenance of orchard -.

### THEORY SCHEDULE

1. Horticulture - Origin, definitions, scope and importance of horticultural crops – Divisions of horticulture and classification and of horticultural crops - area & production statistics.
2. Horticultural zones of India & Tamil Nadu - special features of horticultural crops- Institutions involved in horticulture - Nutritive value of horticultural crops.
3. Propagation – sexual and asexual propagation - Seed propagation – dormancy and measures to overcome seed dormancy, apomixes and polyembryony.
4. Vegetative propagation – merits and demerits – cutting, layering, grafting and budding- rootstock influence – stock / scion relationship
5. Specialized plant parts for propagation and micro propagation –clonal orchards.
6. Growth and development of horticultural plants – climatic factors influencing - light, temperature, wind, humidity and rainfall- Soil factors - kind of soil, soil fertility management'
7. Growth regulators and growth hormones – Classification and applications
8. Physiology of flowering, pollination, fruit set, fruit ripening and senescence –Fruitfulness and causes of unfruitfulness
9. **Mid Semester Examination**
10. Cropping systems – Inter cropping , cover cropping multi-tire cropping - planting methods –high density planting -Crop geometry

11. Inter intercultural operations – weed, water and fertilizer management
12. Bearing habits and crop regulation including training, pruning and special practices.
13. crop regulatory practices for fruit crops and vegetables- Off season production of horticultural crops through cultural methods and growth regulators.
14. Rejuvenation of old and senile orchards
15. Protected cultivation of horticultural crops
16. Pre harvest operations, climacteric and non-climacteric fruits- maturity indices and harvesting methods
17. Pre-cooling – sorting– grading – standards for domestic and export consumption– packing– storage and marketing of produce.

### **PRACTICAL SCHEDULE**

1. Visit to Orchard and study of different features of an orchard
2. Planning, layout and planting of horticultural crops.
3. Machineries, tools and implements used for various horticultural operations.
4. Preparation of potting mixture, potting and repotting of plants
5. Plant propagation structures including mist chamber, shade net, glass houses, poly houses
6. Preparation of growth regulators and method of application in horticultural crops.
7. Demonstration of propagation through layering and cutting.
8. Demonstration of propagation through budding, grafting and top working.
9. Propagation through specialized plant parts
10. Visit to tissue culture laboratory and study of micropropagation protocols and hardening
11. Nutrient and irrigation management practices
12. Bearing habits and training practices in horticultural crops.
13. Pruning practices in horticultural crops.
14. Maturity indices for various horticultural crops
15. Post harvest handling practices viz., grading, sorting and packing techniques.
16. Visit to private orchards and nursery
- 17. Final Practical examination.**

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2. Hartman, H.T., D.E. Kester, Davies Jr. F.T. and Geneve, R.L. 2002. Plant propagation – Principles and Practices – Prentice Hall of India Ltd., New Delhi.
3. Jitendra Singh. 2006. Basic Horticulture. Kalyani Publishers, New Delhi.
4. Kumar, N.2010. Introduction to Horticulture, (7<sup>th</sup> Ed.) Oxford IBH Publication, New Delhi.
5. Rajan, S. and B.L. Markose. 2007. Propagation of horticultural crops. New India Publishing, New Delhi.

**TAM 117: ,yf;fpa';fspy; ntshz;ika[k;  
mwptpay; jkpH;g; gadhf;fKk; 0+1**

**brk;Kiwg; gapw;rp ml;;ltiz**

1. ntshz;ik – brhw; bghUs; tpsf;fk; - bjhy;fhg;gpak; fhL;Lk; epyg;ghFghL kw;Wk; kz;zwptpay;.
2. r';f ,yf;fpa';fspy; ntshz;ikj; bjhHpy; El;g';fs;
3. gjpbdz; fPH;f;fzf;F E}y;fspy; ntshz;ik mwptpay; - jpUf;Fws; - ehd;kzpf;foif - ,dpait ehw;gJ – ,d;dh ehw;gJ – le;jpizbaGgJ – jpizkhiy E}w;iwk;gJ
4. r';f ,yf;fpa';fspy; bey; tiffs; - gs;S E}y;fspy; bey; tiffs;
5. ntshz;ikg; gHbkhHpfs; - cHt[/ tpj/ ehw;W eLjy;/ vU/ ePh;g;ghrdk;/ fis/ gaph;g; ghJfhg;g[/ mWtil/ fsh;epyr; rPh;jpUj;jk;/ thdpay;/ kiH/ gUt';fs; gw;wpa Fwpg;g[fs;
6. ehL;Lg;g[wg; ghly;fs; tHp ntshz;ikr; bra;jpfis mwpjy;
7. mwptpay; jkpHpd; tsh;r;rp epiyfs; - jkpHpy; ntshz;ik ,jH;fs;/ fl;Liur; RUf;fk; (Abstract) vGJ jy;.
8. fUj;Jg; ghpkhw;wj; jpwd;fs; (Communication skills) nkilg; ngr;R – nfl;ly;/ ngRjy;/ goj;jy;/ vGJjiy - nkk;gLj;Jtjw;fhd tHp Kiwfig; gapw;Wtpj;jy;.

**9. ,ilg;gUtj; njh;t[**

10. bkd; jpwd;fis (Soft skills) nkk;gLj;Jjy;.
11. bkhHpbgah;g;g[ - Xh; mwpKfk;. bkhHpbgah;g;g[ tiffis mwpjy; - ntshz; bra;jpfis; jkpHhf;fk; bra;jy;
12. fiyr;brhy;yhf;fk; - fiyr;brhw;fis cUthf;Fk; Kiw – fiyr;brhw;fis; jug;gLj;Jjy; - tl;lhu tHf;Fr; brhw;fis; bjhFj;jy;
13. mwptpay; jkpH; tsh;r;rpapy; fzpdpapd; g';F
14. E}y; Kd;Diu/ mzpe;Jiu/ E}y; kjpg;gPL bra;jy; (kjpg;g[iu)
15. bra;jp tiffs; - bra;jpj;jhs; - thbdhyp – bjhiyf;fhL;rp Mfpa jfty; bjhlh;g[ Clf';fspy; ntshz;ikr; bra;jpfis vGjg; gapw;rp mspj;jy;.
16. ntshz; bjhHpy;El;g';fs; bjhlh;ghd tpsk;guk;/ Jz;Lg; gpuRuk;/ kog;gpjH;fs;/ g[JbkhHpfs;/ ifnaLfs; jahhpj;jy;.
17. fye;Jiuahly;/ neh;fhzy;/ ehlfk;/ ftpij/ tpy;Yg;ghL \yk; ntshz;ikr; bra;jpfis; gug;g[jy;.

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- kzit K!;jgh. ,izaj; jkpH;.
- mide;jpe;jpa mwptpay; jkpH;f; fHfk; - fy;tp El;gtpay;.
- cyfj; jkpHhuha;r;rp epWtdk; - jkpHpd; kug[r; bry;t';fs;.
- ,uh. re;jpunrfud;. bkhHpg; ghLk; - gilg;ghf;fj;jpwd; tsh;j;jy;.

**ENG 117 DEVELOPMENT EDUCATION**  
**(Equivalent course for non-Tamil students)**

**OBJECTIVES**

To enable the learner know, understand, apply and value items related to agriculture and help the farmers to implement them.

**PRACTICAL**

Basic principles of learning- Taxonomy of educational objectives- Transferable skills -Multiple intelligence-Career development-Success story of entrepreneurs-Group learning-Brainstorming, Simulation, Role play, Ice breakers- Transactional communication- Types of ego- Interpersonal communication- Writing- Fax and e-mail, applying for a job, interviews, project report- Strategies and skills- Basic principles of scientific article editing.

**LECTURE SCHEDULE**

1. Basic principles of learning. Binary terms viz., – growth and development, education – for – life and life – long education, motivation and morale – occupation and profession, training and education, lateral thinking and conventional thinking, teaching and learning – discussion.
2. Bloom's classification of educational objectives – Cognitive, Affective, Psychomotor domain(s) – discussion
3. Career development – opportunity for graduates of agriculture and allied sciences – discussion
4. Success story of a farmer – factors involved – role – play
5. Brainstorming – Demonstration
6. Simulation – Convergent task – demonstration
7. Simulation – Divergent task – demonstration
8. Role – pay – interpersonal communication – Fax, email – Transactional communication – ice breaker
- 9. Mid Semester Examination**
10. Verbal and analytical skills – interactive CD-ROM
11. Writing and Editing – demonstration
12. Writing popular articles
13. Project Report – discussion on a mutilated cloze text
14. Project Report – Role play
15. Scientific articles – Selection, organization and presentation – a discussion
16. Writing a scientific article
- 17. Final Practical Examination**

**REFERENCES**

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2. David H. Janessen (2009) *Learning to solve problems: A handbook for solving learning Environments* Routledge. USA
3. Gay Lumsden, Donald Lymsaden, Carolyn Wieyststoff (2009) *Communicating in Groups and Teams: Sharing Leadership*: Wadsworth Cengage Learning. Boston. USA
4. Michael, Michalko. *Thinkertoys: A Handbook of Creative-Thinking Techniques* (2nd Edition) (June 8, 2006) Ten Speed Press. Canada
5. Sudarsanam. R (1985) *Development Education*: Vibhuvan publishers. Coimbatore.

**101 NATIONAL SERVICE SCHEME (0+1)**

**I and II Semester**

Orientation – NSS origin – motto – symbol – NSS administration at different levels – programme planning – Rural Projects – Urban projects – Government schemes – Career guidance – Self help groups – Environment protection – Use of natural energy – Conventional energy resources – Soil and Water conservation – Community health programmes – blood donation camp – government schemes for family welfare – immunization for major diseases – awareness camps - integrated women and child welfare – Education for all .

**III and IV Semester**

Popularization of agro techniques – Self employment opportunities – Animal health, Dairy and Poultry farming – Road safety – Training on First aid and emergency cell. Popularization of small savings – communal harmony and National integration – Evils of alcohol – smoking – AIDS – care of Senior citizens – Personality development – meditation, Yoga Art of living – Activities on the

preservation of National monuments, cultural heritage and folklore – special camp activities – campus development activities.

### **101 NATIONAL CADET CORPS (0+1)**

General - Military History – Introduction to NCC – Aims of NCC – Principles of NCC, NCC organization, Duties of good citizen – system of NCC training – Foot drill – Arms drill – Guard of Honour – Ceremonial Drill – Weapon training – First aid – Rifle and Light machine gun – Map reading – Civil defence – Leadership - Drill – Weapon drill – Weapon training and firing –Civil defence – Ecology / Nature awareness –Adventure Activities – Leadership qualities.

#### **REFERENCE:**

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2. Major R.S.Mishra, 1999. A Handboo of NCC, Kanti Prakashan, 53, Barahi Tola Etawah , U.P.

## **SEMESTER – II**

### **AGR 121: WATER MANAGEMENT (1+1)**

#### **OBJECTIVES**

Obtaining knowledge on the principles and practices of irrigation and interaction among the components of soil, moisture, crop complex.

#### **THEORY**

##### **Unit – I : History and development of irrigation**

History and development of water / irrigation management - Role of water in plant growth – Water resources and irrigation potential of India and Tamil Nadu - History and development of irrigation in India – Importance of irrigation – Irrigation systems of India and Tamil Nadu.

##### **Unit – II : Soil-plant-water relationship**

Water relations – Soil-plant-water relationship - Soil-plant atmospheric – Hydrological cycle – Soil water movement – soil moisture constants - Moisture extraction pattern – Absorption of water – Evapotranspiration – Plant water stress and its effect and methods to overcome stress.

##### **Unit – III : Crop water requirement**

Crop water requirement – Effective rainfall - Potential evapotranspiration (PET) and consumptive use – Definition and estimation – Factors affecting water requirement – Critical stages for irrigation and water requirement of crops – Measurement of irrigation water.

##### **Unit – IV :Micro irrigation and water use efficiency**

Scheduling of irrigation – Different approaches - Methods of irrigation: surface, sub-surface sprinkler and drip irrigation – Micro irrigation layout, suitability, merits and scope – Fertigation, water soluble fertilizer use Water use efficiency – Methods to improve WUE – Conjunctive use of water – on farm water management – Conveyance distribution – water budgeting - Water management for different field crops.

##### **Unit – V: Quality of water and drainage**

Quality of irrigation water – irrigation management under limited water supply – Agronomic practices for use of poor quality water (saline, effluent and sewage water) for irrigation – tank irrigation, well irrigation – on-farm development – command area development –Agricultural drainage, importance and methods of drainage.

#### **PRACTICAL**

Estimation of soil moisture – Measurement of irrigation water through water measuring devices (flumes and weirs) – Calculation of irrigation water requirement ( problems) – Acquiring skill in land shaping for different surface irrigation methods – Operation and economics of sprinkler and drip irrigation systems – Estimation of crop water requirement – Scheduling of irrigation based on different approaches – Irrigation efficiency - Irrigation water quality – On-farm irrigation structures – Visit to irrigation command area (Reservoirs and tanks) and water management institutes - Methods of drainage and observation of drainage structures.

#### **THEORY LECTURE SCHEDULE**

1. History and development of water-Role of water in plants – Water resources of India and Tamil Nadu –
2. Importance of irrigation and Irrigation systems of India and Tamil Nadu.
3. Soil – Plant –water relationship – Soil-plant-atmospheric - Hydrological cycle

4. Soil water movement- soil moisture constants -absorption of water and evapotranspiration.
5. Plant water stress – causes – plant response and adaptations – method to overcome plant water stress.
6. Crop water requirement – factors affecting crop water requirement – effective rainfall - potential evapotranspiration (PET), consumptive use (CU) – definition and estimation.
7. Available soil moisture – definition and importance – moisture extraction pattern - soil physical characteristics (texture, structure, porosity, bulk density and particle density) in influencing irrigation – soil moisture estimation methods
8. Factors affecting crop water requirement– Critical stages for irrigation – water requirement for different field crops.
9. **Mid-Semester Examination**
10. Scheduling of irrigation – criteria based on plant, soil moisture - different approaches - climatological approach, empirical methods, crop co-efficient.
11. Methods of irrigation – surface (flooding, beds and channels, border strip, ridges and furrows, broad bed and furrows, surge irrigation) and sub-surface methods.
12. Micro irrigation system (drip and sprinkler irrigation) – suitability, components, layout, operation, advantage and disadvantage. –Fertigation –water soluble fertilizers
13. Water use efficiency – definition and concept – methods to improve WUE – conjunctive use of water- water budgeting
14. Water management for cereals, pulses and oilseeds
15. Water management for commercial crops (cotton, sugarcane, sugar beet, tobacco)
16. Quality of irrigation water – irrigation management under limited water supply- Agronomic practices for use of poor quality water (saline, effluent and sewage water).
17. Tank irrigation, well irrigation - on farm development – command area development and Agricultural drainage – importance of drainage and different methods of drainage.

#### **PRACTICAL SCHEDULE**

1. Estimation of soil moisture by gravimetric method and tensiometer
2. Estimation of soil moisture by resistance blocks and neutron probe and other improved devices
3. Measurement of irrigation water with flumes and weirs
4. Calculation of irrigation water based on source, water flow, soil moisture status and depth of irrigation.
5. Land leveling and land shaping - Beds and channels - ridges and furrows.
6. Land leveling and land shaping for border strips - broad bed furrow method of irrigation.
7. Layout, operation and maintenance of drip and sprinkler irrigation systems.
8. Estimation of crop water requirement by direct and indirect methods
9. Scheduling of irrigation based on indicator plants, soil-sand mini plot technique
10. Scheduling of irrigation based on depletion of available soil moisture and IW/CPE ratio.
11. Calculations on irrigation efficiency parameters
12. Assessment of irrigation water quality parameters.
13. Observation of irrigation structures in wetlands and irrigated dry lands.
14. Visit to irrigation command area and study of command area development.
15. Observation on drainage structures during on / off campus field visit.
16. Visit to water management and training institute
17. **Practical Examination.**

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## ENT 122: INSECT MORPHOLOGY, SYSTEMATICS AND PHYSIOLOGY (2+1)

### OBJECTIVES:

- To study the basic structure and modifications of insect appendages.
- To study the physiology and behavior of insects.
- To know the position of insects in Animal kingdom by studying their taxonomic characters.

### THEORY

#### Unit I: History and Importance

Entomology as a science – branches of Entomology - History of Entomology in India – Importance and scope of entomology in Agriculture and Horticulture. Origin of insects - Position of insects in the animal kingdom – Classification and Characters of phylum Arthropoda. Relationship of class Insecta with other classes of Arthropoda. Reasons for insect dominance.

#### Unit II: Morphology and Behaviour

Body segmentation, Structure and functions of insect cuticle- cuticular appendages and moulting. Basic Structures of head, thorax and abdomen and their appendages. Modifications of insect antennae, mouth parts, legs, wings, wing venation and wing coupling apparatus. Modifications in abdomen and its appendages. Types of Metamorphosis- egg, larva and pupa. Insect behaviour – tropisms, biocommunication (Sound and light production), rhythm, diapause, migration, defense and offence.

#### Unit III: Classification and characters of Apterygota and Exopterygota

Taxonomy – Definition and importance. Binomial nomenclature. Classification of insects – orders and examples. Distinguishing characters of agriculturally important orders of Apterygotes - Collembola and Thysanura. Distinguishing characters of agriculturally important orders of Exopterygotes - Odonata, Phasmida, Dictyoptera, Dermaptera, Isoptera, Psocoptera, Mallophaga, Siphunculata and Thysanoptera. Distinguishing characters of agriculturally important orders of Exopterygotes up to families of economic importance - Orthoptera (Acrididae, Tettigoniidae, Gryllidae and Gryllotalpidae), Heteroptera (Tingidae, Reduviidae, Miridae, Pentatomidae, Coreidae, Pyrrhocoridae, Lygaeidae, Nepidae, Belastomatidae, Gerridae, Cimicidae) and Homoptera (Cicadidae, Cicadellidae, Delphacidae, Aphididae, Cercopidae, Membracidae, Aleyrodidae, Coccidae, Diaspididae, Pseudococcidae, Kerridae and Psyllidae).

#### Unit IV: Classification and characters of Endopterygota

Distinguishing characters of agriculturally important orders of Endopterygotes - Siphonaptera and Strepsiptera. Distinguishing characters of agriculturally important orders of Endopterygotes up to families of economic importance – Neuroptera (Chrysopidae, Myrmeleonidae, Mantispidae, Ascalaphidae), Coleoptera (Cicindellidae, Carabidae, Dytiscidae, Curculionidae, Apionidae, Staphylinidae, Coccinellidae, Lampyriidae, Hydrophilidae, Scarabaeidae, Dynastidae, Cerambycidae, Melolonthidae, Anobiidae, Tenebrionidae, Bruchidae, Meloidae, Cetonidae, Buprestidae, Elateridae and Bostrychidae), Diptera (Cecidomyiidae, Agromyzidae, Tephritidae, Asilidae, Tabanidae, Tachinidae, Hippoboscidae, Culicidae, Syrphidae and Muscidae), Lepidoptera (Nymphalidae, Lycaenidae, Pieridae, Papilionidae, Satyriidae, Crambidae, Pyraustidae, Noctuidae, Arctiidae, Bombycidae, Cochlidiidae, Geometridae, Gelechiidae, Pterophoridae, Saturniidae, Sphingidae, Lymantriidae and Hesperidae) and Hymenoptera (Tenthredinidae, Apidae, Xylocopidae, Megachilidae, Bombidae, Sphecidae, Vespidae, Formicidae, Chalcididae, Ichneumonidae, Bethylinidae, Braconidae, Evaniidae, Encyrtidae, Eulophidae and Trichogrammatidae).

#### Unit V: Anatomy and physiology

Elementary knowledge on Anatomy of digestive, excretory, respiratory, circulatory, nervous and reproductive systems in insects. Structure of male and female genitalia. Types of reproduction and Mating. Functions of secretory (Exocrine and Endocrine) glands. Sensory organs and their functions.

### PRACTICAL

Methods of collection and preservation of insects including immature stages - Preparation of Riker mount. Observations on segmentation and external features of Grasshopper/cockroach/Blister beetle. Observations on various types of insect head orientation, antennae, mouthparts, legs, wings, wing venation, and wing coupling apparatus and abdominal appendages. Studies on types of eggs, larvae and pupae. Demonstration of digestive system and male and female reproductive systems in grasshopper/cockroach. Observing the characters of agriculturally important orders - Collembola, Thysanura, Odonata, Phasmida, Orthoptera, Dictyoptera, Dermaptera, Isoptera, Psocoptera, Mallophaga, Siphunculata, Thysanoptera, Heteroptera, Homoptera, Neuroptera, Siphonaptera, Strepsiptera, Coleoptera, Lepidoptera, Diptera and Hymenoptera.

**Assignment:** Each student has to submit five pinned insects of various orders, five double mounted insects, one riker mount and immature stage of insect (wet preservation).

### THEORY LECTURE SCHEDULE

1. Definition and branches of Entomology, Its history and importance in Agriculture and horticulture. Origin of insects, Position of insects in the animal kingdom.

2. Characters of phylum Arthropoda and its classes.
3. Factors responsible for Insect dominance.
4. Segmentation and Structure of Insect body wall and cuticular appendages.
5. Moulting process in insects.
6. Basic Structures of head and its appendages, modifications of insect antennae.
7. Modifications of insect mouth parts.
8. Basic Structures of thorax and its appendages, modifications of legs, wings, wing venation and wing coupling apparatus.
9. Basic Structures of abdomen and its appendages.
10. Metamorphosis and types of eggs, larvae and pupae.
11. Tropism, Biocommunication in insects — Sound and light production, diapause, migration, defense and offence in insects.
12. Taxonomy – Definition, importance and binomial nomenclature. Classification of insects - Apterygotes, Exopterygotes, Endopterygota with examples.
13. Distinguishing characters of orders Collembola, Thysanura, Odonata, Phasmida, and Orthoptera (Acrididae, Tettiigonidae, Gryllidae and Gryllotalpidae).
14. Distinguishing characters of orders Dictyoptera, Dermaptera, Isoptera, and Thysanoptera
15. Distinguishing characters of orders Psocoptera, Mallophaga and Siphunculata
16. Distinguishing characters of orders Heteroptera and Homoptera and families of agricultural importance.
17. **Mid Semester Examination**
18. Distinguishing characters of orders Strepsiptera and Siphonaptera.
19. Distinguishing characters of order Coleoptera and families of agricultural importance.
20. Distinguishing characters of order Diptera and families of agricultural importance.
21. Distinguishing characters of order Lepidoptera and families of agricultural importance.
22. Distinguishing characters of order Hymenoptera and families of agricultural importance.
23. Elementary knowledge on digestive system, structure of alimentary canal and its modifications in certain groups.
24. Elementary knowledge on Digestive enzymes, digestion and absorption of nutrients.
25. Elementary knowledge on excretory system in insects - malpighian tubules - accessory excretory organs and physiology of excretion.
26. Elementary knowledge on respiratory system in insects - structure of trachea - tracheoles
27. Types of respiratory system - Spiracles - respiration in aquatic and endoparasitic insects.
28. Elementary knowledge on circulatory system in insects - haemocoel and dorsal vessel - circulation of blood -composition of haemolymph - haemocytes and their functions.
29. Elementary knowledge on nervous system in insects - structure of neuron – types of nervous systems.
30. Elementary knowledge on Nerve impulse conduction - axonic and synaptic transmissions.
31. Elementary knowledge on Male and female reproductive systems in insects – structure and modifications. Spermatogenesis and Oogenesis. Structure of male and female genitalia.
32. Types of reproduction - oviparous, viviparous, paedogenesis, polyembryony ovoviporous and parthenogenesis.
33. Elementary knowledge on structure and functions of Exocrine and Endocrine glands
34. Structure of sense organs - types of sensilla – photoreceptors, chemoreceptors and mechanoreceptors.

### **PRACTICAL SCHEDULE**

1. Practicing the methods of collection, killing, pinning, labelling, display and preservation of insects including immature stages. Preparation of riker mount.
2. Observations on segmentation and external features of grasshopper / cockroach/ Blister beetle.
3. Observations on various types of insect head orientation and antennae.
4. Demonstration of mouth parts of cockroach and plant bug and study of mouth parts of female mosquito, honeybee, thrips, antlion grub, housefly and butterfly.
5. Observations on the modifications in legs and wings (wing venation, regions, angles and wing coupling).
6. Observations on various types of abdominal appendages.
7. Studies on the types of metamorphosis. Observations on immature stages of insects – Eggs, larvae and pupae.
8. Observation on Distinguishing characters of Collembola, Odonata, Phasmida and Orthoptera (Families: Acrididae, Tettiigonidae, Gryllidae and Gryllotalpidae).
9. Observation on Distinguishing characters of Dictyoptera, Dermaptera, Isoptera and Thysanoptera.
10. Observation on Distinguishing characters of Heteroptera (Families: Reduviidae, Pentatomidae, Miridae, Coreidae, Pyrrhocoridae, Lygaeidae, Nepidae, Belastomatidae, Gerridae, Cimicidae, Tingidae), Homoptera (Families: Cicadidae, Cicadellidae, Delphacidae, Aphididae, Cercopidae,



- Membracidae, Aleyrodidae, Coccidae, Diaspididae, Pseudococcidae, Kerridae and Psyllidae).
11. Observation on Distinguishing characters of Coleoptera (Families: Cicindellidae, Carabidae, Dytiscidae, Curculionidae, Apionidae, Staphylinidae, Coccinellidae, Gyrinidae, Lampyriidae, Hydrophilidae, Scarabaeidae, Dynastidae, Cerambycidae, Melolonthidae, Anobiidae, Tenebrionidae, Bruchidae, Meloidae, Cetonidae, Buprestidae, Elateridae and Bostrychidae).
  12. Observation on Distinguishing characters of Neuroptera (Families: Chrysopidae, Myrmeliontidae, Mantispidae and Ascalaphidae),
  13. Observation on Distinguishing characters of Lepidoptera (Families: Nymphalidae, Lycaenidae, Pieridae, Papilionidae, Satyriidae, Crambidae, Pyraustidae, Noctuidae, Arctiidae, Bombycidae, Cochlidiidae, Geometridae, Gelechiidae, Pterophoridae, Saturniidae, Sphingidae, Lymantriidae and Hesperidae)
  14. Observation on Distinguishing characters of Diptera (Families: Cecidomyiidae, Agromyzidae, Tephritidae, Asilidae, Tabanidae, Tachinidae, Hippoboscidae, Culicidae, Syrphidae and Muscidae).
  15. Observation on Distinguishing characters of Hymenoptera (Families: Tenthredinidae, Apidae, Xylocopidae, Megachilidae, Bombidae, Sphecidae, Vespidae, Formicidae, Chalcididae, Ichneumonidae, Bethyidae, Braconidae, Evaniidae, Encyrtidae, Eulophidae and Trichogrammitidae).
  16. Demonstration of digestive system and male and female reproductive systems (grasshopper/cockroach)
  17. **Final Practical Examination**

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1. Awasthi, V.B. 2007. Introduction to general & applied entomology (2nd ed.) Scientific Publishers, Jodhpur. 394 p.
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## PAT123 PRINCIPLES OF PLANT PATHOLOGY (2+1)

### OBJECTIVES

The subject covers basic aspects of plant pathology including history, taxonomy, general characters of fungi, bacteria, virus, algae and phanerogams and also symptoms of various plant diseases with its causal agent.

### THEORY

#### Unit I: Plant Pathogenic organisms

Introduction – Definition – Plant Pathology – History of Plant Pathology- Classification of plant diseases - Causes of plant diseases- Biotic and abiotic – Plant Pathogenic Organisms – Fungi, Bacteria, Phytoplasma, Spiroplasma, Fastidious vascular bacteria, Viruses, Viroids, Algae, Protozoa and Phanerogamic Parasites

#### Unit II: Pathogenesis

Pathogenesis - Mode of infection – Pre-penetration, penetration and post penetration – Spread and survival of pathogens - Role of enzymes and toxins on disease development

#### Unit III: General characters and molecular phylogeny of fungi

General characters of fungi – somatic structures, types of fungal mycelia - Modification of mycelia – reproduction in fungi (Vegetative, asexual and sexual) –nutrition in fungi- Disease cycle – Symptoms of fungal diseases - Classification based on molecular phylogeny. I Kingdom: Protozoa, Phylum: Plasmodiophoromycota, Class: Plasmodiophoromycetes (Plasmodiophorales) II. Kingdom: Chromista, Phylum: Oomycota, Class :Oomycetes (Pythiales and Peronosporales). III. Kingdom: Fungi. Phylum: Chytridiomycota, Class: Chytridiomycetes (Chytridiales, Spizellomycetales); Phylum: Blastocladiomycota, Class: Blastocladiomycetes (Physodermaceae); Phylum: Zygomycota, Class : Zygomycetes (Mucorales).

#### Unit IV: Phylum : Ascomycota and Basidiomycota

Phylum: Ascomycota, Classes: Taphrinomycetes (Taphrinales), Dothideomycetes (Dothidiales, Capnodiales and Pleosporales) Eurotiomycetes (Eurotiales), Leotiomycetes (Erysiphales and Helotiales), Sordariomycetes (Hypocreales, Phyllochorales and Diaporthales) and mitosporic ascomycetes; Phylum: Basidiomycota, Classes: Agaricomycetes (Agaricales, Corticiales, Cantharellales

and Polyporales), Pucciniomycetes (Pucciniales) and Ustilaginimycetes (Exobasidiales, Ustilaginales and Tilletiales).

#### Unit V: Bacteria, Phytoplasma and Viruses

Classification of bacteria - general characters and symptoms of phytopathogenic bacteria –mode of entry and spread -general characters and symptoms of Phytoplasma, Spiroplasma, Fastidious vascular bacteria, viruses, viroids, algae, Phanerogamic parasites and Abiotic disorders.

#### PRACTICAL

Study of important taxonomic characters and symptoms produced by *Plasmodiophora*, *Pythium*, *Phytophthora*, *Albugo*, *Sclerospora*, *Peronospora*, *Peronosclerospora*, *Pseudoperonospora*, *Plasmopara*, *Mucor*, *Rhizopus*, *Taphrina*, *Capnodium*, *Erysiphe*, *Phyllactinia*, *Uncinula*, *Leveillula*, *Claviceps*, *Puccinia*, *Uromyces*, *Hemileia*, *Sphacelotheca*, *Tolyposporium*, *Ustilago*, *Agaricus*, *Pleurotus*, *Calocybe*, *Volvariella*, *Ganoderma*, *Colletotrichum*, *Gloeosporium*, *Pestalotia*, *Macrophomina*, *Botryodiplodia*, *Pyricularia*, *Sarocladium*, *Drechslera* (*Helminthosporium*), *Alternaria*, *Cercospora*, *Curvularia*, *Rhizoctonia*, *Sclerotium*, Symptoms of bacterial, Phytoplasma, Fastidious vascular bacteria, Algal parasite, phanerogamic parasites and non-parasitic diseases/disorders

Note: Students should submit 50 well-preserved specimens

#### THEORY SCHEDULE

1. Definition of Plant Pathology – History of Plant Pathology
2. Causes of Plant diseases – biotic and abiotic- Biotic factors- fungi – bacteria, virus, viroid, and Phytoplasma.
3. Fastidious vascular bacteria – Spiroplasma – Algal and phanerogamic parasites- abiotic disorders
4. Pathogenesis - Mode of infection – pre-penetration, penetration and post penetration
5. Spread and survival of pathogens
6. Role of enzymes on disease development
7. Role of toxins on disease development
8. General characters of fungi- types of Mycelia – modification of mycelia, vegetative reproduction
9. Asexual and sexual reproduction in fungi
10. Fruiting bodies in fungi- Asexual and sexual
11. Nutrition / parasitism in fungi- Types of parasitism –parasite, saprophyte, facultative saprophyte, facultative parasite, obligate parasite, Biotrophs, hemibiotrophs, perthotrophs, necrotrophs, and symbiosis
12. Classification of Kingdom – Protozoa - important taxonomic characters and Symptoms and life cycle of *Plasmodiophora brassicae* and *Spongospora subterrenea*
13. Classification of Kingdom –Chromista- General characters - Classification of Oomycetes
14. Symptoms and life cycle of *Pythium*, *Phytophthora* and *Albugo*,
15. Symptoms and life cycle of *Peronosclerospora*, *Sclerospora*, *Perenospora*, *Pseudoperenospora* and *Plasmopara*
16. Classification of Kingdom– Chytridiomycota and Zygomycota - important characters, symptoms and life cycles of *Rhizopus* and *Mucor*
17. Mid Semester Examination
18. Classification of Kingdom– Ascomycota- important characters
19. Symptoms and life cycles of *Erysiphe*, *Leveillula*, *Phyllactinia*, *Uncinula* and *Podosphaera*
20. Symptoms and life cycles of *Taphrina*, *Capnodium*, *Eurotium*, *Talaromyces*, *Claviceps* and *Venturia*,
21. Symptoms and important characters of *Pyricularia*, *Sarocladium*, *Helminthosporium*, *Alternaria*, *Cercospora*, *Curvularia*, *Fusarium* and *Verticillium*
22. Symptoms and important characters of *Colletotrichum*, *Gloeosporium*, *Pestalotia*, *Macrophomina*, *Botryodiplodia*, *Septoria* and *Ascochyta*
23. Classification of Kingdom - Basidiomycota- important characters
24. Symptoms and life cycles of *Puccinia*, *Uromyces*, and *Ustilago*
25. Symptoms and life cycles of *Ganoderma* and *Exobasidium*.
26. Important taxonomic characters of *Agaricus*, *Pleurotus*, *Volvariella* and *Calocybe*
27. Symptoms and important characters of *Corticium*, *Rhizoctonia* and *Sclerotium*
28. Classification and general characters of phytopathogenic bacteria- Mode of entry and spread
29. Symptoms and characters of *Xanthomonas* and *Pseudomonas* / *Ralstonia*, *Erwinia* (*Pantoea*), *Agrobacterium*, *Corynebacterium* (*Clavibacter*.) and *Streptomyces*
30. Virus - definition, nature and properties of plant virus, Single stranded, Double stranded RNA and DNA viruses and Transmission of plant viruses
31. Common symptoms of virus diseases – bract mosaic, citrus tristeza, tomato Spotted wilt, Sunflower necrosis, papaya ring spot, infectious chlorosis, yellow mosaic, vein clearing, leaf crinkle, leaf curl, bud necrosis, rosette and bunched top

32. Important characters and symptoms of phytoplasma diseases – Phyllody, witches broom, little leaf, yellow dwarf and sandal spike
33. Important characters and symptoms of Viroid , Fastidious vascular bacteria, Algal and Phanerogamic parasites
34. Symptoms and characters of non-parasitic diseases

#### **PRACTICAL SCHEDULE**

1. General characters of fungi – Types of mycelia -Types of vegetative, asexual and sexual spores- asexual and sexual fruiting bodies.
2. Study of important taxonomic characters and symptoms produced by *Plasmodiophora*, *Pythium* and *Phytophthora*.
3. *Albugo*, *Sclerospora*, *Peronospora*, *Peronosclerospora* *Pseudoperonospora* and *Plasmopara*
4. *Mucor* and *Rhizopus*.
5. *Taphrina*, *Capnodium* *Erysiphe*, *Phyllactinia*, *Uncinula*, *Leveillula* and *Claviceps*.
6. *Puccinia*, *Uromyces* , and *Hemileia*
7. *Sphacelotheca*, *Tolyposporium* and *Ustilago*.
8. Study of important taxonomic characters of *Agaricus*, *Pleurotus*, *Calocybe*, *Volvariella* and *Ganoderma*.
9. Study of important taxonomic characters and symptoms produced by *Colletotrichum*, *Gloeosporium* ,*Pestalotia*, *Macrophomina* and *Botryodiplodia*
10. Study of important taxonomic characters and symptoms produced by *Pyricularia*, *Sarocladium* *Helminthosporium*, *Alternaria*, *Cercospora* and *Curvularia*, *Rhizoctonia* and *Sclerotium*.
11. Symptoms of bacterial diseases – leaf blight, leaf streak, canker, scab, crown gall, wilt and soft rot.
12. Symptoms and vectors of viral diseases – infectious chlorosis, mosaic, vein clearing, leaf crinkle, leaf curl, bud necrosis, rosette, bunchy top, bract mosaic, citrus tristeza, tomato spotted wilt, sunflower necrosis, papaya ring spot
13. Symptoms of Phytoplasma and fastidious vascular bacterial diseases.
14. Study of important characters and symptoms produced by algal parasite and phanerogamic parasites
15. Symptoms of non-parasitic diseases
16. Field visit
17. Final practical examination.

Note: Students should submit 50 well-preserved specimens

#### **REFERENCES**

1. Agrios, G.N. 2005. Plant Pathology – (5<sup>th</sup> Edition). Academic Press, New York.
2. Dube, H.C.2009. A textbook of Fungi, Bacteria and Viruses, Vikas Publishing House P. Ltd, New Delhi.
3. Singh, R.S.1982. Plant Pathogens – The Fungi. Oxford and IBH Publishing Co., New Delhi.
4. Darwin Christdhas Henry. 2009. Illustrated Plant Pathology- Basic Concept. New India Publishing Agency, New Delhi.
5. Vidyasekaran, P. 1993. Principles of Plant Pathology –. CBS Publishers & Distributors, New Delhi.

### **SAC 124 INTRODUCTION TO SOIL SCIENCE (2+1)**

#### **OBJECTIVES**

This course provides knowledge on the fundamentals of soil science and impart skills in collecting and analyzing soils for basic physical, physico-chemical and chemical properties for using it as a medium for plant growth

#### **THEORY**

##### **Unit I: Earth, Rocks and Minerals**

Soil – Pedological and edaphological concepts – Origin of the Earth – Composition of Earth's crust - Soil forming rocks and minerals - origin and Classification

##### **Unit II: Soil Formation**

Weathering of rocks and minerals - Physical, chemical and biological weathering – Factors of Soil formation - active and passive. Soil forming processes - fundamental and specific soil forming processes- Soil profile description

##### **Unit III: Physical Properties**

Soil physical properties – Soil texture- Particle size analysis - textural classes - Soil structure and classification – Soil consistency. Bulk density, particle density and porosity, soil compaction - Soil colour

#### **Unit IV: Physical Properties**

Soil water- Soil water potentials – Soil moisture constants – Movement of soil water – saturated and unsaturated flow – Infiltration, percolation, permeability and drainage – Methods of determination of soil moisture. Thermal properties of soils -Soil temperature , Soil air – Gaseous exchange, - influence of soil moisture,temperature and soil air on plant growth .

#### **Unit V: Chemical Properties, Organic matter and Humus**

Soil colloids – Properties, types and significance – Layer silicate clays – their genesis and sources of charges – Ion exchange – CEC, AEC – Factors influencing Ion exchange - significance. Soil reaction, Buffering capacity and EC.

Soil organic matter – Composition – decomposition and mineralization, C: N ratio, Carbon cycle – Fractions of soil organic matter – Humus formation. Soil organisms - Beneficial and harmful effects.

#### **PRACTICAL**

Identification of rocks and minerals - Study of a soil profile - collection and processing of soil samples - Determination of bulk density, particle density and porosity – Particle size analysis — International pipette method - Soil moisture determination – Gravimetric method, gypsum block, tensiometer,neutron probe moisture meter. Determination of infiltration rate and hydraulic conductivity - Soil colour – Munsell colour chart - Soil temperature. Analytical Chemistry-Basic concepts,techniques and calculations. Soil pH and EC - - Chemical constituents of soil - Water soluble cations and anions, Organic carbon .Field study of different soil types.

#### **THEORY LECTURE SCHEDULE**

1. Soil definition – soil as a natural body – Major components of soil by volume pedological and edaphological concepts.
2. Origin of Earth – theories – planetesimal and nebular hypothesis - Composition of Earth's crust.
3. Rocks – definition, classification – igneous, sedimentary rock- formation and classification - Brief description of important rocks
4. Metamorphic rocks- formation and classification - Brief description of important rocks
5. Minerals – definition, classification - important soil forming primary minerals - ferro and non-ferro magnesium minerals
6. Formation of secondary minerals – silicate minerals-clay minerals and amorphous minerals and non silicate minerals
7. Weathering – types of weathering – physical weathering of rocks – agents of physical weathering and their role
8. Chemical weathering – solution, hydration, hydrolysis, carbonation, oxidation and reduction; Biological weathering – role of flora and fauna in weathering process
9. Soil profile – detailed description of a theoretical soil profile – differences between surface soil and sub soil.
10. Factors of soil formation - Active and Passive soil forming factors
11. Fundamental soil forming process – elluviation, illuviation and humification. Specific Soil forming processes – podzolization, laterization, salinization, alkalization, calcification, decalcification, pedoturbation
12. Soil physical properties – soil texture – definition – particle size analysis- Stoke's Law – assumptions and limitations – various textural classes in soil -their properties and significance
13. Soil structure – classification – types, classes and grades of soil structure – importance of soil structure and its management
14. Soil consistence – consistence of wet and dry soils – soil crusting – soil plasticity – Atterberg's plastic limits – factors affecting plastic limits – significance of soil consistence
15. Density of soil – bulk density and particle density – factors affecting density parameters – importance of bulk density of soil – soil compaction – its importance – calculation of porosity
16. Soil colour – components – Munsell colour chart- Factors influencing soil colour -significance of soil colour.
17. Soil water-pF concept – soil moisture characteristic curves – importance of soil water.
18. Mid- Semester Examination
19. Soil water potential – components of water potentials – soil moisture constants – field capacity, wilting coefficient, hygroscopic water and saturation – available water and methods for determining soil moisture.
20. Soil water movement – Darcy's Law – saturated, unsaturated and vapour flows – infiltration, percolation and permeability – distribution of water in profile in different soils – soil drainage and its importance
21. Soil temperature – sources of heat – heat capacity and conductivity – factors influencing soil temperature – modification of soil thermal regimes – measurement of soil temperature – importance of soil temperature on crop growth – management of soil temperature and importance.

22. Soil air – compositions of atmospheric air and soil air – gaseous exchange – influence of soil air on plant growth – measures to improve soil aeration.
23. Soil colloids – definition – general properties – shape, surface area, electrical charge, adsorption, flocculation, deflocculation, plasticity, cohesion, swelling, shrinkage, Tyndall effect and Brownian movement
24. Secondary silicate clay minerals of different types – kaolinite, illite, montmorillonite and chlorite – properties – allophanes
25. Origin of charge in organic and inorganic colloids – negative and positive charges – differences between organic and inorganic soil colloids.
26. Adsorption of ions – types of ion exchange – cation and anion exchange – cation and anion exchange capacities of soil
27. Base saturation – factors affecting ion exchange capacity of soils – importance of Cation Exchange Capacity (CEC) of soils – calculation of base exchange capacity and exchangeable acidity.
28. Soil reaction (pH) – definition, pH scale, factors affecting soil pH, buffering capacity – signification
29. Soil Electrical Conductivity – factors affecting EC – significance
30. Soil biology – biomass – flora and fauna – their important characteristics – role of beneficial organisms – organic matter decomposition, mineralization and immobilization.
31. Soil organic matter – various sources – composition – compounds in plant residues – their decomposability – humus – definition – synthesis of humus
32. Importance of soil organic matter and humus – fractionation of soil humus – carbon cycle – carbon : nitrogen (C:N) ratio of commonly available organic residues – significance of C:N ratio in soil fertility
33. Soil classification – order, sub order, great group and family series – nomenclature according to soil taxonomy
34. Important soil groups of India – alluvial soils, black soils, red soils, laterite soils and coastal sands

#### **PRACTICAL SCHEDULE**

1. Identification of common rocks and minerals
2. Study of soil profiles & Soil sample collection
3. Preparation of primary and secondary standard solutions
4. Determination of bulk density, particle density and porosity – cylinder, wax coating and core methods.
5. Soil textural analysis –International pipette method (Soil dispersion)
6. International pipette method (clay , clay+silt)
7. International pipette method (Coarse sand and fine sand)
8. Determination of soil colour.
9. Determination of soil moisture– Gravimetric and gypsum block method
10. Determination of soil moisture–Tensiometer, and neutron probe
11. Determination of Infiltration rate and hydraulic conductivity
12. Determination of soil pH and EC
13. Estimation of soil organic carbon
14. Determination of Water soluble cations
15. Determination of Water soluble anions
16. Preparation of interpretative reports of soil analysis and assignments
17. Practical Examination

#### **REFERENCES**

1. Biswas T.D. and Mukherjee S.K., 1987. Text Book of Soil Science Tata - McGraw Hill Publishing Co. Ltd., New Delhi
2. Brady, N.C., 2002 The Nature and Properties of Soils (13<sup>th</sup> Edition) McMillan Co., New York. Indian Publisher – Eurasia Publishing House (P) Ltd., Ramnagar, New Delhi – 553.
3. Dilip Kumar Das. 2004. Introductory Soil Science, Kalyani Publishers, Ludhian
4. Indian Society of Soil Science, 2009 Fundamentals of Soil Science. ISSS Publication, IARI, New Delhi
5. Sahai, V.N. 2001. Fundamentals of Soil , Kalyani Publishers, Ludhiana
6. Sekhon, G.S. Eds., 2002 Fundamentals of Soil Science Indian Society of Soil Science, 2009 IARI, New Delhi

## GPB 125: GENETICS AND CYTOGENETICS 2+1

### OBJECTIVES

- To impart knowledge on inheritance and variation and to understand the parallelism between the behavior of chromosomes and genes.
- To understand the modern concepts of genetics at molecular level.

### THEORY

#### Unit I: Cytology

Earlier concepts of heredity-Definition of genetics, heredity, inheritance, cytology, cytogenetics; cell and cell organelles – Prokaryotes and Eukaryotes. Cell division – mitosis, meiosis and their significance, cell cycle - Sporogenesis-gametogenesis, Fertilization-Identical and fraternal twins.

#### Unit II: Mendelian laws and Quantitative inheritance

Mendel's Work – Laws of heredity- Chromosomal theory of inheritance. Allelic interactions – Dominance vs. recessive, complete dominance, codominance, incomplete dominance, over dominance; Non allelic interaction – gene interactions- Lethal genes, Pleiotrophy, Penetrance and Expressivity, phenocopy: Multiple alleles, Quantitative inheritance – Multiple factor hypothesis modifying genotypes of gene action controlling quantitative traits.

#### Unit III: Quantitative inheritance, Linkage and Crossing over

Linkage and Crossing over- Estimation of strength of linkage and recombination - cytological proof for crossing over - Two point and three point test cross; Double cross over, interference and coincidence; genetic map, physical map. Cytoplasmic inheritance and Maternal effects.

#### Unit IV: Chromosomes, Chromosomal variation and Sex determination

Chromosome structure, chemical composition, nucleosome, centromere, telomere, euchromatin, heterochromatin, NOR, satellite chromosome, karyotype, ideogram – chromosome banding; Types of chromosomes- Special chromosomes-Variation in chromosome number and structure –Aneuploidy and Euploidy-its genetic cytological implications and evolutionary significance. Definition of eugenics and eugenics-Nondisjunction-Klinefelter's syndrome and Turner syndrome-autosomes and allosomes- sex determination - Genic balance theory -Sex linked - sex influenced and sex limited inheritance.

#### Unit V: Modern concept of genetics and mutation

Experiments showing DNA as genetic material – DNA Structure and function- DNA replication- RNA as genetic material – types of RNA– genetic code-Central dogma of life; gene expression- protein synthesis; Regulation of gene expression – Operon model ; Cistron, muton and recon; Complementation test; exons, introns – split genes – plant genome structure; Mobile genetic elements; Meaning of Developmental genetics, DNA methylation, siRNA, RNA<sub>i</sub>, Functional genomics, Metagenomics, Transcriptomics, Proteomics, Metabolomics and Phenomics. Mutation – Mutagens-characteristics of mutation – CIB technique - molecular basis of mutation.

### PRACTICAL

Study of cell and cell organelles – Preparation of fixatives and stains – pre treatment of materials for mitosis and meiosis – study of mitosis and meiosis. Study of genetic ratios of monohybrid, dihybrid – incomplete dominance. Gene interaction - multiple alleles and multiple factors. Study of linkage, estimation of strength of linkage and recombination frequency in two point and three point test cross data and F<sub>2</sub> data – Drawing of genetic map – interference and coincidence.

### THEORY SCHEDULE

1. Definition of genetics, heredity, inheritance, cytology, cytogenetics; Brief history of developments in genetics and cytogenetics.
2. Physical basis of heredity: Structure and function of cell and cell organelles – Differences between Prokaryotes and Eukaryotes.
3. Pre-Mendelian ideas about heredity – Vapour and fluid theory, Magnetic power theory, Preformation theory, Lamarck's theory, Darwin's theory, Germplasm theory and Mutation theory.
4. Cell division – mitosis, meiosis and their significance, cell cycle; zygote formation and embryo development - identical and fraternal twins.
5. Work of Mendel – Characters studied reasons for Mendel's success, Law of dominance, Law of segregation and Law of independent assortment. Rediscovery of Mendel's work
6. Chromosomal theory of inheritance. Allelic interactions – Dominance vs. recessive, complete dominance, codominance, incomplete dominance, over dominance.
7. Terminologies: gene, allele, locus, homozygous, heterozygous, hemizygous, genotype, phenotype, monohybrid, dihybrid, trihybrid, polyhybrid.
8. Deviation from Mendelian inheritance – Non allelic interaction without modification in Mendelian ratio – Batson and Punnet's experiment on fowl comb shape. Non allelic interaction with modification in Mendelian ratio – i.) Dominant epistasis (12:3:1)

9. ii.) Recessive epistasis(9:3:4) iii.) Duplicate and additive epistasis((9:6:1). iv.) Duplicate dominant epistasis(15:1)
10. v) Duplicate recessive epistasis (9:7) vi.) Dominant and recessive epistasis(13:3); Summary of epistatic ratios (i)to (vi).
11. Lethal genes, Pleiotrophy, penetrance and expressivity, phenocopy: Multiple alleles, blood group in humans, coat colour in rabbits, self incompatibility in plants; pseudo alleles, isoalleles.
12. Quantitative inheritance – Multiple factor hypothesis – Nilsson Ehle, his experiment on wheat kernel colour.
13. Polygenes – transgressive segregation, comparison of quantitatively and qualitatively inherited characters; modifiers; Types of gene action controlling quantitative traits.
14. Linkage - coupling and repulsion; Experiment on Bateson and Punnett – Chromosomal theory of linkage of Morgan – Complete and incomplete linkage, Linkage group.
15. Crossing over – significance of crossing over; cytological proof for crossing over - Stern's experiment; Factors controlling crossing over.
16. Strength of linkage and recombination; Two point and three point test cross. Double cross over, interference and coincidence; genetic map, physical map.

### 17. Mid Semester Examination

18. Cytoplasmic inheritance and maternal effects – features of cytoplasmic inheritance, chloroplast, mitochondrial - plastid colour in *Mirabilis jalapa* - iojap gene of maize, cytoplasmic male sterility in rice, kappa particles of paramecium - plasmid and episomic inheritance.
19. Chromosome structure, chemical composition, nucleosome, centromere, telomere, euchromatin, heterochromatin, NOR, satellite chromosome, karyotype, ideogram – chromosome banding.
20. Types of chromosomes based on position of centromere, based on structure and function.
21. Special chromosomes - polytene, lampbrush, based on the role in sex determination: autosomes and allosomes, Other types of chromosomes - B, ring and isochromosomes.
22. Chromosomal aberration: Variation in chromosome structure – deletion, duplication, inversion and translocation – genetic and cytological implications.
23. Chromosomal aberration: Variation in chromosome number – euploid, aneuploid, types of aneuploids and their origin; Nondisjunction - Klinefelter syndrome and Turner syndrome; Definition of eugenics and euthenics.
24. Polyploid - auto and allopolyploids, their characters; meaning of genome; evolution of wheat, triticale, cotton, tobacco, brassicas,
25. Sex determination: Autosomes and sex chromosomes - chromosomal theory of sex determination - different types – sex determination in human, fowl, butterfly, grasshopper, honey bee, fumea; Genic balance theory of Bridges, quantitative theory, hormonal theory, barr bodies, metabolic differentiation theory; Gynandromorphs – sex reversal in chicken
26. Sex linked inheritance – criss cross inheritance – reciprocal difference; holandric genes; sex influenced and sex limited inheritance.
27. Sex determination in plants – Melandrium, papaya, maize.
28. DNA, the genetic material – Griffith's experiment, experiment of Avery, McCleod and McCarthy – confirmation by Hershey and Chase; RNA as genetic material – Frankel, Conrat and Singer experiment.
29. Structure of DNA – Watson and Crick model – Central dogma of life
30. Proof for semi conservative method of DNA replication; Models of DNA replication; steps involved in DNA replication.
31. RNA types - mRNA, tRNA, rRNA; genetic code, transcription.
32. Translation – protein synthesis; Regulation of gene expression – operon model of Jacob and Monad; Structural genes and regulator genes;
33. Cistron, muton and recon; Complementation test; exons, introns – split genes – plant genome structure; Mobile genetic elements; Meaning of Developmental genetics, , DNA methylation, siRNA, RNA<sub>i</sub>, Functional genomics, Metagenomics, Transcriptomics, Proteomics, Metabolomics and Phenomics.
34. Mutation – characteristics of mutation – micro and macro mutation – CLB technique - molecular basis of mutation; major physical and chemical mutagens.

### PRACTICAL SCHEDULE

1. Use of microscopes and study of cell shapes and cell organelles of active mitotic and meiotic tissues.
2. Principles of killing and fixing; preparation of stains and preservatives.
3. Study of the mitotic phases in root tips of onion / *Aloe sp.*
4. Study of behaviour of chromosomes in mitosis.
5. Procedure for fixing and observing different meiotic phases in the inflorescence of maize.
6. Procedure for fixing and observing different meiotic phases in the inflorescence in pearl millet/ sorghum/ forest tree.
7. Observation of bivalents, trivalents, quadrivalents and chromosome banding

8. Repetition of meiotic studies in maize/ sorghum/ pearl millet/ forest tree and making temporary and permanent slides.
  9. Principles of dominance, recessive, back cross, test cross, incomplete dominance, codominance and lethal factor; Chi square test; Monohybrid genetic ratio with dominance, with incomplete dominance and test cross.
  10. Dihybrid ratio with dominance, with incomplete dominance and test cross
  11. Simple interaction of genes-comb character in fowls; Dominant epistasis.
  12. Recessive epistasis, Duplicate and additive epistasis.
  13. Duplicate dominant epistasis, Duplicate recessive epistasis, Dominant and recessive epistasis.
  14. Multiple alleles and polygenic inheritance
  15. Estimation of linkage with F<sub>2</sub> and test cross data; Coupling and repulsion.
  16. Problems on two point test cross and three point test cross; Working out interference, coincidence and drawing genetic maps.
- 17. Final Practical examination.**

## REFERENCES

1. Anbuselvam, Y., R.Elangaimannan, T. Sabesan, Y. Anitha Vasline and P. Karthikeyan.2010. Genetics and Cytogenetics;Manivasagar Publications,Chennai-23
2. Singh, B.D. 2004. Fundamentals of genetics, Kalyani Publishers, New Delhi – 110 002.
3. Stansfield, W.D.1990. Theory and problems of genetics. Mc-Graw Hill Book Co., New York
4. Strick berger. M.W. 1996. Genetics. Prentice-Hall of India Pvt. Ltd. New Delhi.
5. Verma,P.S. and V.K.Agarwal. 2007. Genetics. S.Chand and Company Ltd., New Delhi.

## AEC 126: PRINCIPLES OF AGRICULTURAL ECONOMICS (1+1)

### OBJECTIVES

The objective of this course is to provide knowledge to the students about basic concepts of economics and their practical importance.

### THEORY

#### Unit I Nature and Scope of Economics

Nature and scope of economics: Importance – subject matter, science vs. art, positive vs. normative science - deductive and inductive methods. Different economic systems: merits and demerits. Definitions of Economics: wealth, welfare, scarcity and growth definitions. Divisions of Economics – micro and macro economics - Agricultural Economics: definition and scope. Basic concepts: goods, service, value, cost, price, wealth, welfare. Wants: characteristics and classification.

#### Unit II Theory of Consumption

Utility: definition, measurement - cardinal and ordinal utility - Marginal utility - law of diminishing marginal utility & law of equi-marginal utility: definition – assumptions - limitations and applications - Demand: Definition - Kinds of demand, Demand schedule, Demand curve, law of demand, determinants of demand - extension and contraction - increase and decrease in demand - Elasticity of Demand: types, degrees of price elasticity of demand, methods of measuring elasticity, factors influencing elasticity of demand - importance of elasticity of demand - Engel's law of family expenditure – Indifference curve - consumer's surplus: definition – importance.

#### Unit III Theory of Production

Concept of production – Factors of production: Land and its characteristics. Labour – division of labour - malthusian theory and modern theory of population. Capital – characteristics of capital - capital formation – entrepreneur, characteristics and functions of entrepreneur. Supply - definition – law of supply – factors influencing supply- elasticity of supply.

#### Unit IV Theory of Distribution

Pricing of factors of production. Rent and Ricardian theory of rent – quasi rent - wage – real wage and money wage – marginal productivity theory of wage. Interest – liquidity preference theory. Profit – risk bearing theory of profit.

#### Unit V Macroeconomic Concepts

National Income: Concepts – GNP, GDP, NNP, disposable income and per capita income - measurement of national income. Public Finance: Meaning, principles. Public revenue: meaning, classification of taxes - service tax - canons of taxation. Public Expenditure: Principles - money: Functions of money. Inflation: Meaning, definition, kinds of inflation. Welfare Economics: meaning, Pareto's optimality – Millennium Development Goals (MDG).



## THEORY SCHEDULE

1. Nature and scope of economics: Importance – subject matter, science vs. art, positive vs. normative science - deductive and inductive methods. Different economic systems: merits and demerits.
2. Definitions of economics – Wealth, welfare, scarcity and growth definitions. Divisions of Economics – micro and macro economics. Agricultural economics: Definition and scope.
3. Basic concepts – Goods, service, value, cost, price, wealth, welfare. Wants: characteristics and classification.
4. Utility: Definition, measurement - cardinal and ordinal utility - marginal utility - law of diminishing marginal utility & law of equi-marginal utility - definition – assumptions - limitations and applications.
5. Demand: Definition - kinds of demand, demand schedule, demand curve, law of demand, determinants of demand - extension and contraction - increase and decrease in demand.
6. Elasticity of demand: Types, degrees of price elasticity of demand, methods of measuring elasticity, factors influencing elasticity of demand - importance of elasticity of demand.
7. Engel's law of family expenditure - consumer's surplus - definition – importance.
8. **Mid Semester Examination.**
9. Concept of production – factors of production – land and its characteristics. Labour: Division of labour.
10. Malthusian theory and modern theory of population.
11. Market Structure – Price determination in perfect competition & monopoly.
12. Capital – characteristics of capital - capital formation – Entrepreneur, characteristics and functions of entrepreneur.
13. Supply: Definition – law of supply – factors influencing supply – elasticity of supply.
14. Pricing of factors of production – rent and Ricardian theory of rent – quasi rent - wage – real wage and money wage – marginal productivity theory of wage.
15. Interest – liquidity preference theory – profit – risk bearing theory of profit - National Income: Concepts – GNP, GDP, NNP, disposable income and per capita income - measurement of national income.
16. Public Finance: Meaning, principles. public revenue: Meaning, classification of taxes - service tax - canons of taxation, public expenditure - principles.
17. Inflation: Meaning, definition, kinds of inflation - Welfare Economics: Meaning, Pareto's optimality - Millennium Development Goals (MDG).

## PRACTICAL SCHEDULE

1. Exercise on Law of Diminishing Marginal Utility
2. Exercise on Law of Equi Marginal Utility
3. Demand schedule - graphical derivation of individual and market demand
4. Indifference curve analysis – properties, budget line and consumer equilibrium
5. Measurement of arc elasticity and point elasticity of demand - Estimation of own price elasticity, income and cross elasticity of demand
6. Estimation of consumer surplus
7. Exercise on law of diminishing marginal returns – relationship between TPP, APP and MPP
8. Cost concepts and graphical derivation of cost curves
9. Analysis of growth in population and food grain production in India
10. Estimation of supply elasticity
11. Market Structure – Price determination
12. Analysis of causes of inflation and control measures. Measurement of inflation –consumer price index and wholesale price index
13. Types and functions of money
14. Approaches to computation of National Income
15. Analysis of trends in National Income and study of structural changes in the economy
16. Exercise on welfare indicators – HDI, PQLI, PPP, Poverty Line, etc

### 17. Final Practical Examination

## REFERENCES

1. Dewett, K.K. 2002. Modern Economic Theory, Syamlal Charitable Trust, New Delhi.
2. Koutsoyiannis, A. 1983. Modern Microeconomics, The Macmillan Press Ltd., Hongkong
3. Samuelson, P. 2004. Economics, Tata Mcgraw-Hill, New Delhi.
4. Seth, M.L. 2000. Principles of Economics, Lakshmi Narain Agarwal Co., Agra. New Delhi
5. Varian, H. R. 1987. Intermediate Microeconomics, WW Norton & Company, New Delhi.

## AEX 127 FUNDAMENTALS OF RURAL SOCIOLOGY AND EDUCATIONAL PSYCHOLOGY (2+0)

### OBJECTIVES

- To learn the concepts related to sociology and psychology
- To learn the application of the concepts in connection with agricultural extension
- To learn the concepts related to learning experience

### THEORY

#### Unit I: Extension Education and Rural Sociology

Extension Education and Agricultural Extension – Meaning, Definition, Scope and Importance. Sociology and Rural Sociology, Meaning, Definition, Scope, Importance of Rural Sociology in Agricultural Extension and Interrelationship between Rural Sociology & Agricultural Extension. Indian Rural Society, Important characteristics, Differences and Relationship between Rural and Urban societies.

#### Unit II: Sociology

Social Groups – Meaning, Definition, Classification. Motivation - Meaning and Definition Role of Social groups in Agricultural Extension. Social Stratification –Meaning, Definition, Functions. Forms of Social stratification –Characteristics and – Differences between Class & Caste System. Cultural concepts –Culture, Customs, Folkways, Mores, Taboos, Rituals and Traditions – Meaning, Definition and their Role in Agricultural Extension. Social Values and Attitudes – Meaning, Definition, Types and Role of Social Values and Attitudes in Agricultural Extension.

#### Unit III: Social Organisation

Social Institutions– Meaning, Definition, Major institutions in Rural society, Functions and their Role in Agricultural Extension. Social Organizations – Meaning, Definition, Types of organizations and Role of Social organizations in Agricultural Extension. Social Control – Meaning, Definition, Need of social control and Means of Social control. Social change – Meaning, Definition, Nature of Social change, Dimensions of social change and factors of social Change.

#### Unit IV: Leadership

Leadership – Meaning, Definition, Classification, Roles of a leader, Different methods of Selection of Professional and Lay leaders. Training of Leaders – Meaning, Definition, Methods of training, Advantages and Limitations in use of local leaders in Agricultural Extension. Psychology and Educational Psychology – Meaning, Definition, Scope and Importance of Educational Psychology in Agricultural Extension.

#### Unit V: Teaching-Learning Process

Intelligence –Meaning, Definition, Types, Factors affecting intelligence and Importance of intelligence in Agricultural Extension. Personality – Meaning, Definition, Types, Factors influencing the Personality and Role of personality in Agricultural Extension. Teaching – Learning process –Meaning and Definition of Teaching, Learning, Learning experience and Learning situation, Elements of learning situation and its characteristics. Principles of learning.

### THEORY SCHEDULE

1. Extension Education and Agricultural Extension – Meaning, Definition, Scope and Importance.
2. Sociology and Rural Sociology, Meaning, Definition, Scope, Importance of Rural Sociology in Agricultural Extension
3. Interrelationship between Rural Sociology & Agricultural Extension.
4. Indian Rural Society, Important characteristics, Differences and Relationship between Rural and Urban societies.
5. Social Groups – Meaning, Definition, Classification,
6. Motivation – Meaning and Definition Role of Social groups in Agricultural Extension.
7. Social Stratification –Meaning, Definition, Functions.
8. Forms of Social stratification
9. Characteristics and – Differences between Class & Caste System.
10. Cultural concepts –Culture, Customs, Folkways, Mores, – Meaning, Definition and their Role in Agricultural Extension
11. Taboos, Rituals and Traditions – Meaning, Definition and their Role in Agricultural Extension.
12. Social Values and Attitudes – Meaning, Definition, Types
13. Role of Social Values and Attitudes in Agricultural Extension.
14. Social Institutions– Meaning, Definition, Major institutions in Rural society,
15. Functions and their Role of social institutions in Agricultural Extension.
16. Social Organizations – Meaning, Definition, Types of organizations
17. Mid-semester Examination
18. Role of Social organizations in Agricultural Extension.

19. Social Control – Meaning, Definition, Need of social control and Means of Social control
20. Social change – Meaning, Definition, Nature of Social change,
21. Dimensions of social change and factors of social Change
22. Leadership – Meaning, Definition, Classification, Roles of a leader,
23. Different methods of Selection of Professional and Lay leaders.
24. Training of Leaders – Meaning, Definition, Methods of training,
25. Advantages and Limitations in use of local leaders in Agricultural Extension.
26. Psychology and Educational Psychology – Meaning, Definition, Scope and Importance of
27. Educational Psychology in Agricultural Extension.
28. Intelligence – Meaning, Definition, Types, Factors affecting intelligence
29. Importance of intelligence in Agricultural Extension.
30. Personality – Meaning, Definition, Types, Factors influencing the Personality
31. Role of personality in Agricultural Extension.
32. Teaching – Learning process – Meaning and Definition of Teaching, Learning,
33. Learning experience and Learning situation,
34. Elements of learning situation and its characteristics.
35. Principles of learning .

## REFERENCES

1. Adivi Reddy, A 2001. Extension Education – Sree Lakshmi Press, Bapatla.
2. Chauhan S.S 2001. Advanced Educational Psychology, Vikas Pub House Pvt. Ltd., New Delhi.
3. Chitambar, J.B. 1997, Introductory Rural Sociology, Wiley Eastern Limited, New Delhi
4. Mangal S.K. 2000. Educational Psychology, Prakash Brothers, Ludhiana
5. Vidya Bhushan and Sachdeva, 2003. An Introductory to Sociology, Kitab Mahal, Allahbad.

## COM 128 INTRODUCTION TO COMPUTER APPLICATIONS (1+1)

### OBJECTIVES

To make use of computer basic personal usage and to know how to use MS-office (word, Excel, Access, Power point) to increase personal and academic productivity. To get exposed to aspects of internet usage and to propagate the awareness of research facilities using browsing and searching.

### THEORY

#### Unit – I: Introduction to Computer

Introduction to Computers, Anatomy of Computers, Input and Output Devices, Units of Memory, Hardware, Software and Classification of Computers. Personal Computers, Types of processors, booting of computer, warm and cold booting. Computer Viruses, Worms and Vaccines, Operating System-DOS and WINDOWS. Disk Operating System (DOS): Some fundamental DOS commands. FORMAT, DIR, COPY, PATH, LABEL, VOL, MD, CD and DELTREE, Rules for naming files in DOS and Types of files.

#### Unit – II: WINDOWS

WINDOWS: GUI, Desktop and its elements, WINDOWS Explorer, working with files and folders, setting time and date, starting and shutting down of WINDOWS. Anatomy of a WINDOW. Title Bar, Minimum, Maximum and Close Buttons, Scroll Bars, Menus and Tool Bars.

#### Unit – III: MS-Word & Excel

Applications – MSWORD: Word, processing and units of document, features of word-processing packages. Creating, Editing, Formatting and saving a document in MSWORD; MSEXCEL: Electronic Spread sheets, concept, packages. Creating, Editing and Saving a spreadsheet with MSEXCEL. Use of in-built Statistical and other functions and writing expressions. Use of Data Analysis Tools, Correlation and Regression, t-test for two-samples and ANOVA with one-way Classification. Creating Graphs.

#### Unit – IV: MS-Power point & Access

MS Power Point: Features of Power Point Package. MSACCESS: Concept of Database, Units of database, creating database.

#### Unit – V: Principles of Programming & Internet

Principles of Programming: Flow Charts and Algorithms, illustration through examples. Internet: World Wide Web (www), Concepts, Web Browsing and Electronic Mail.

### THEORY SCHEDULE

1. Introduction to Computers, Anatomy of Computers.
2. Input and Output Devices, Units of Memory, Hardware, Software and Classification of Computers.
3. Personal Computers, Types of processors, booting of computer, warm and cold booting. Computer Viruses, Worms and Vaccines.

4. Operating System-DOS and WINDOWS. Disk Operating System (DOS): Some fundamental DOS commands. FORMAT, DIR, COPY, PATH, LABEL, VOL, MD, CD and DELTREE, Rules for naming files in DOS and Types of files.
5. WINDOWS: GUI, Desktop and its elements, WINDOWS Explorer, working with files and folders, setting time and date, starting and shutting down of WINDOWS.
6. Anatomy of a WINDOW. Title Bar, Minimum, Maximum and Close Buttons, Scroll Bars, Menus and Tool Bars.
7. MSWORD: Word, processing and units of document, features of word-processing packages.
8. Creating, Editing, Formatting and saving a document in MSWORD.
9. Mid-semester examination.
10. MSEXCEL: Electronic Spread sheets, concept, packages, Creating, Editing and Saving a spreadsheet with MSEXCEL.
11. Use of in-built Statistical and other functions and writing expressions.
12. Use of Data Analysis Tools, Correlation and Regression, t-test for two-samples and ANOVA with one-way Classification.
13. Creating Graphs.
14. MS Power Point: Features of Power Point Package.
15. MSACCESS: Concept of Database, Units of database, creating database.
16. Principles of Programming: Flow Charts and Algorithms, illustration through examples.
17. Internet: World Wide Web (www), Concepts, Web Browsing and Electronic Mail.

### **PRACTICAL SCHEDULE**

1. Exposure to computer-H/W & S/W – Power Switch On/ Off.
2. DOS commands: TIME, DATE, DIR, COPY, FORMAT, VOL, LABEL, PATH.
3. Windows GUI – usage(Handling Desktop).
4. Using Icons, understanding clicks, double clicks.
5. MS-Word – create/edit/print documents.
6. MS-Word – Formatting, Inserting, Table creation, Alignment.
7. MS-Excel – creating spreadsheet, Formatting cells, Auto calculation.
8. MS-Excel – Inbuilt functions, chart preparations.
9. MS-Access – Database creation.
10. MS-Access – Structuring with different types of field.
11. MS-Access – Report generation.
12. MS-Power point – preparation of slides on power point
13. MS-Power point – Animation Control, Transition Control
14. Transforming the data of WORD, EXCEL and ACCESS to other formats
15. Creating of E-Mail-ID
16. Email- Compose, Attaching, Inbox printing, Browsing a web page.
17. Practical examination.

### **REFERENCE**

1. Arthur Naiman. 1985. Introduction to word processing, BPB Publication, New Delhi.
2. Balagurusamy, E. 1990. Basic programming including IBM PC, Prentice Hall of India, New Delhi.
3. Microsoft – GWBASIC users guide and user manual, 1981 and 1988, reproduced by HCL – HP under licence.
4. Rajaraman. 1971. Computer Oriented Numerical Methods. Prentice Hall of India, New Delhi.
5. Rajaraman. 1984. Principles of Computer Programming. Prentice Hall of India, New Delhi.

## **AEG 129 FARM POWER AND MACHINERY (1+1)**

### **OBJECTIVES**

- This subject will enable the student,
- To gain knowledge on the various types of I C engines, types and selection of tractors.
- To understand the construction and working of various farm implements like tillage implements, seed drills, transplanters, plant protection and harvesting equipments.

### **THEORY**

#### **Unit I: Farm power**

I C Engine – classification - Working principle of two stroke and four stroke I C engine - basic principle and operation of CI and SI engines and comparison.

#### **Unit II: Tractors and its maintenances**

Tractors and power tillers – types and uses. Selection of tractor and cost of tractor power -service – repairs, maintenance and lubrication– fuel – oil and miscellaneous cost.

### **Unit-III: Primary and secondary tillage Implements**

Tillage-objectives-furrow terminology-methods of ploughing -field capacity and working our problems. Primary tillage implements-components and functions of indigenous ploughs-mould board, disc, rotary and chisel ploughs. Secondary tillage implements –components and functions of tillers, harrows, ridger, bund former, puddler, leveler and green manure trampler.

### **Unit -IV: Sowing and plant protection Equipments.**

Sowing methods –equipment used –seed cum fertilizer drills and plants –components –functions. Area coverage, cost of equipment. Plant protection equipment –sprayers –classification and uses, dusters –types and uses. Light trap, suction type banana injector, tree sprayers and other plant protection equipments.

### **Unit V: Intercultural, Harvesting equipments.**

Intercultural, implements – sweep – junior hoe – weeders – types and uses, area coverage and cost of operation. Harvesting equipment – principles – components – functions - threshers – types – principle of operation, - equipment for land development and soil conversation.

### **THEORY LECTURE SCHEDULE**

1. Working principles of IC engines and CI engines – farm mechanisms.
2. Tractors and power tillers parts and their working principles – maintenance
3. Introduction about tillage – ploughing – methods – furrow terminology.
4. Various primary tillage implements – working principle and uses.
5. Secondary tillage implements - working principle and uses.
6. Area coverage – simple problems – maintenance.
7. Sowing methods and sowing equipments.
8. Sprayers and dusters – types and uses – advantages.
9. Other plant protection equipment - working principle and uses.
10. Simple problems – area coverage – cost of operation
11. Intercultural implements – weeders – types and uses.
12. Harvesting and threshing equipments – calculation of threshing efficiency.
13. Combine – working principle – parts and uses.
14. Equipment for land development and soil conversation.

### **PRACTICAL SCHEDULE**

1. Study of different components of IC engines.
2. Study and working principle of four stroke IC engine.
3. Study and working principle of two stroke IC engine.
4. Study of Tractors and power tillers.
5. Identification of primary tillage implements – indigenous ploughs and mould board ploughs.
6. Identification of disc, rotary and TNAU ploughs.
7. Identification of harrows, ridger and bun former.
8. Identification of puddler leveler and green manure trampler.
9. Seed drill – parts – working principles
10. Identification of paddy harvester and thresher.
11. Identification of plant protection equipments – sprayers and dusters.

### **REFERENCE BOOKS**

1. Bindra O.S.and Harcharan Singh, 1971, Pesticide applicant equipment. Oxford and IBH pub co. New Delhi
2. Jagadishwar Shay, 1992, Elements of agricultural engineering Jain brother, New Delhi.
3. Michel and T.P. Ojha, 1996 principles of agricultural engineering jain brother.
4. Srivstava A.C. 1990, elements of farm machinery. Oxford and IBH pub co., New Delhi.
5. Khurmi R.s. Thermal Engineering, S. Chand & Co., New Delhi, 14<sup>th</sup> ed. 2005.

## SEMESTER – III

### AGR 211 CROP PRODUCTION (0+1)

#### OBJECTIVES

Objective of the course is to gain hands-on training in raising a wet land crop.

Each student will be allotted a minimum land area and he / she will do all field operations in the allotted land from field preparation to harvest and processing of irrigated puddled lowland rice

#### PRACTICAL

- Rice (*Transplanted rice or Direct sown rice*):
- **Transplanted rice:**
- Rice ecosystems – Climate and weather – Seasons and varieties of Tamil Nadu
- Preparation of nursery - Application of manures to nursery - seed treatment - Forming nursery beds and sowing seeds - Weed management and plant protection to nursery
- Preparation of main field - Application of organic manures – Green manuring - Bio-fertilizers - Pulling out seedlings and transplanting – SRI - Application of herbicides – Water management – Nutrient management - Plant protection measures – Mechanization in rice cultivation - Recording growth, yield attributes and yield
- Harvesting, threshing, drying and cleaning the produce - Working out cost of cultivation and economics.

#### PRACTICAL SCHEDULE

##### *Transplanted rice:*

1. Study of rice ecosystems, climate, weather, seasons and varieties of Tamil Nadu
2. Selection of nursery area, preparation of nursery, application of manures and fertilizer to nursery
3. Acquiring skill in seed treatment, seed soaking and incubation, nursery sowing and management
4. Study and Practice of main field preparation and puddling operations
5. Practicing of field preparatory operations – sectioning of field bunds and plastering, leveling and basal application of fertilizers
6. Practicing transplanting techniques in lowland rice
7. Estimation of plant population and acquiring skill in gap filling and thinning and study of weeds and weed management in rice
8. Estimation of LAI and DMP
9. **Mid-Semester Examination**
10. Study and practice of green manuring and bio-fertilizer application in rice
11. Acquiring skill in nutrient management and practicing top dressing techniques
12. Study of water management practices for lowland rice
13. Observation of insect pests and diseases and their management
14. Recording growth and other related characters of rice and Estimation of yield and yield parameters in rice
15. Harvesting, threshing and cleaning of the produce
16. Working out cost of cultivation and economics
17. **Final Examination**

#### REFERENCES

1. Annadurai. K. and B Chandrasekaran. 2009. A Text Book of Rice Science. Scientific Publishers
2. Chidida Singh. 2010. Modern techniques of raising field crops. Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi.
3. Crop Production Guide. 2005. Directorate of Agriculture, Chennai and Tamil Nadu Agricultural University, Coimbatore.
4. ICAR 2006. Hand book of Agriculture. Indian Council of Agriculture, New Delhi.

## AGR 212: AGRONOMY OF FIELD CROPS – I (2+1)

### OBJECTIVES

Learning about the origin of field crops and its importance. Acquiring knowledge on agronomical aspects of various field crops such as cereals, millets, pulses and oilseeds.

### THEORY

#### Unit – I: Agronomy of cereals

Cereals: Rice, Maize, Wheat, Oat, Barley, Rye and Triticale - Origin, geographic distribution, economic importance, soil and climatic requirements, varieties, cultural practices (from land preparation to harvest) and yield.

#### Unit – II: Agronomy of major and minor millets

Millets: Sorghum, Pearl millet, Finger millet, Small millets, Foxtail millet, little millet, Kodo millet and common millet - Origin, geographic distribution, economic importance, soil and climatic requirement, varieties, cultural practices and yield.

#### Unit – III: Agronomy of pulses

Pulses: Red gram, Black gram, Green gram, Bengal gram, Horse gram, Cowpea, Soybean and Lentil - Origin, geographic distribution, economic importance, soil and climatic requirement, varieties, cultural practices and yield.

#### Unit – IV: Agronomy of major oilseeds

Oil seeds: Groundnut, sesame, sunflower, coconut, castor, Jatropha - Origin, geographic distribution, economic importance, soil and climatic requirement, varieties, cultural practices, yield.

#### Unit – V: Agronomy of minor oilseeds

Oil seeds: Mustard, Rapeseed, safflower and Linseed - Origin, geographic distribution, economic importance, soil and climatic requirement, varieties, cultural practices, yield.

### PRACTICAL

Identification of crops and crop varieties - Rice nursery preparation and transplanting - main field preparation for millets, pulses and oilseeds; Seed treatment techniques - Estimation of population - Sowing and manuring- Seeding equipment's - Study of growth and yield contributing characters, yield calculations, harvesting and yield estimation of above crops; Cost and returns - Study of cropping patterns and important agronomic experiments and farmers' fields.

### THEORY LECTURE SCHEDULE

1. Introduction-importance of cereals, millets, pulses and oilseeds
2. Area, production and productivity of major cereals and millets of India and Tamil Nadu.
3. Importance and area, production and productivity of pulses and oilseeds crops of India and Tamil Nadu.
4. Rice- Origin - geographic distribution - economic importance – varieties - soil and climatic requirement
5. Rice - cultural practices –Deficiency symptoms for major and micronutrients- yield - economic benefits
6. Special type of Rice cultivation – SRI, Transgenic Rice - Hybrid rice.
7. Maize - Origin, geographic distribution, economic importance, soil and climatic requirement, varieties, cultural practices and yield.
8. Wheat - Origin, geographic distribution, economic importance,
9. Wheat- Soil and climatic requirement, varieties, cultural practices and yield.
10. Barley and Oats - Origin, geographic distribution, economic importance, soil and climatic requirement, varieties, cultural practices and yield
11. Rye and Triticale - Origin, geographic distribution, economic importance, soil and climatic requirement, varieties, cultural practices and yield.
12. Sorghum - Origin, geographic distribution, economic importance, soil and climatic requirement
13. Sorghum- varieties, cultural practices and yield.
14. Pearl millet - Origin, geographic distribution, economic importance, soil and climatic requirement, varieties, cultural practices and yield
15. Finger millet - Origin, geographic distribution, economic importance, soil and climatic requirement, varieties, cultural practices and yield.
16. Minor millets - Origin, geographic distribution, economic importance, soil and climatic requirement, varieties, cultural practices and yield.
17. Black gram and Green gram - Origin, geographic distribution, economic importance, soil and climatic requirement, varieties, cultural practices and yield - Agronomy of rice fallow pulses
18. Mid-semester Examination
19. Red gram - Origin, geographic distribution, economic importance, soil and climatic requirement, varieties, cultural practices and yield.

20. Bengal gram and Horse gram - Origin, geographic distribution, economic importance, soil and climatic requirement, varieties, cultural practices and yield - Agronomy of rice fallow pulses
21. Cowpea and Lentil - Origin, geographic distribution, economic importance, soil and climatic requirement, varieties, cultural practices and yield - Agronomy of rice fallow pulses
22. Soybean - Origin, geographic distribution, economic importance, soil and climatic requirement, varieties, cultural practices and yield.
23. Groundnut - Origin, geographical distribution, economic importance,
24. Groundnut- Soil and climatic requirements - varieties, cultural practices yield and economics
25. Sesame– Origin, geographical distribution, economic importance,
26. Sesame-Soil and climatic requirements, varieties, cultural practices and yield.
27. Sunflower - Origin, geographical distribution, economic importance,
28. Sunflower- Soil and climatic requirements, varieties, cultural practices and yield.
29. Coconut– Origin, geographical distribution, economic importance, soil and climatic requirements, varieties, cultural practices and yield
30. Castor and Jatropha – Origin, geographical distribution, economic importance, soil and climatic requirements, varieties, cultural practices and yield
31. Mustard, - Origin, geographical distribution, economic importance, soil and climatic requirements, varieties, cultural practices and yield
32. Rapeseed - Origin, geographical distribution, economic importance, soil and climatic requirements, varieties, cultural practices and yield.
33. Safflower - Origin, geographical distribution, economic importance, soil and climatic requirements, varieties, cultural practices and yield
34. Linseed - Origin, geographical distribution, economic importance, soil and climatic requirements, varieties, cultural practices and yield

### **PRACTICAL**

1. Identification of cereals, millets, pulses and oilseed crops in the crop cafeteria
2. Practicing various nursery types and main field preparation for rice crop.
3. Nursery and main field preparation for important millets, pulses and oilseeds
4. Acquiring skill in different seed treatment techniques in important field crops
5. Estimation of plant population per unit area for important field crops
6. Acquiring skill in field preparation, sowing and manuring of crops under pure and intercropping situations for cereals and millets
7. Acquiring skill in field preparation, sowing and manuring of crops under pure and intercropping situations for pulses and oilseeds.
8. Acquiring skill in using seed drill for sowing operations.
9. Acquiring skill in foliar nutrition for important field crops.
10. Observations on growth parameters of cereals and millets
11. Observations on growth parameters of pulses and oilseeds.
12. Study of yield parameters and estimation of yield in cereals and millets
13. Study of yield parameters and estimation of yield in pulses and oilseeds
14. Working out cost and returns of important cereals, millets, pulses and oilseeds crops.
15. Visit to farmers field / research stations to study the cultivation techniques of cereal, millets, pulses and oilseeds
16. Visit to nearby Agricultural Research Station / Farmer's field
17. **Practical Examination**

### **REFERENCES**

1. Chidda Singh. 2010. Modern techniques of raising field crops. Oxford and IBH Publishing Co. Pvt. Ltd, New Delhi
2. Hand Book of Agriculture. 2006. Indian Council of Agrl. Research, New Delhi.
3. Rajendra Prasad. 2004. Text Book on Field Crop Production, Indian Council of Agrl. Research, New Delhi.
4. Singh. S.S. 2002. Crop Management. Kalyani Publishers, New Delhi
5. Tomar,G.S., Taunk,S.K. and Choudhary,J.L. 2011. Science of Crop Production Part I. Kushal Publications and Distributors, Varanasi (U.P.).



## ENT 213: BENEFICIAL INSECTS AND INTRODUCTORY NEMATOLOGY (0+1)

### OBJECTIVES:

- To study the techniques in rearing honey bees, silkworm and lac insects
- To know about minor productive insects and their importance
- To study the basic morphology and biology of important plant parasitic nematodes.

### PRACTICAL

#### Unit I: Apiculture

Species of bees, structural adaptations, life history – bee castes, duties, social behaviour, bee pasturage, bee foraging, communication and swarming. Apiary – selection of site - bee-keeping appliances and seasonal management. Bee enemies, diseases of bees, bee pollination and bee products and their uses.

#### Unit II: Sericulture

Silkworm Types- mulberry silkworms and non –mulberry silkworms – eri, tasar and muga silkworms. Voltinism - multivoltine - bivoltine - bivoltine hybrids – double hybrids, Biology of mulberry silkworm, Moriculture - varieties - mulberry cultivation - harvesting – preservation of leaves. Mulberry silk worm rearing - rearing house - room and bed disinfectants – Chawki rearing – Rearing of late age worms. Mounting – mountages – harvesting of cocoons. Pests and diseases of mulberry silkworm and their management.

#### Unit III: Lac Culture and Minor Productive Insects

Lac insect – species, morphology, biology and secretion of lac. Host plants of lac insect. Lac production – Seed lac –Button lac- Shellac. Lac products – Uses of lac. Minor productive insects - Cochineal insect, Gall insect, Food and Medicinal value of insects, Aesthetic and Scientific value of insects.

#### Unit IV: Nematode Morphology

Nematology - Position of nematodes in animal kingdom- Importance of plant parasitic and entomophilic nematodes. Elementary knowledge on morphology and anatomy of nematodes – segmentation, cuticle, cephalic region, alimentary, excretory, reproductive and nervous system. Sense organs.

#### Unit V: Nematode Biology, Damage and Extraction

Biology of important plant parasitic nematodes - *Meloidogyne*, *Heterodera*, *Globodera*, *Tylenchulus*, *Pratylenchus*, *Rotylenchulus*, *Aphelenchoide*, *Radopholus* and *Ditylenchus*. Damages of nematodes in important crops. Extraction of nematodes - Soil and root sampling, Cobb's sieving method, Baermann funnel technique and modified Baermann funnel technique, sugar flotation technique, cysts by conical flask technique, fenwick can method and Incubation and Blender technique.

**Assignment:** Each student has to submit a report on Economics of bee keeping/ Economics of sericulture/entomophilic nematodes/Plant parasitic nematodes.

### PRACTICAL SCHEDULE

1. Acquaintance with honey bee species, castes of bees and structural adaptation,
2. Life history – bee castes – duties – social behaviour.
3. Bee pasturage, bee foraging, communication and swarming. Bee enemies and diseases of bees
4. Bee-keeping appliances and seasonal management, site selection for apiary, Bee pollination, bee products and their uses.
5. Silkworm types – mulberry, eri, tasar and muga silkworms. Voltinism - multivoltine - bivoltine - bivoltine hybrids – double hybrids. Studies on biology of mulberry silkworm.
6. Mulberry cultivation, Mulberry varieties and Methods of harvesting and preservation of leaves.
7. Chawki rearing – feeding, cleaning and spacing, late age worms rearing – feeding, cleaning, spacing. Mounting – mountages – harvesting of cocoons.
8. Pests and diseases of mulberry silkworm and their management. Identification of rearing appliances of mulberry silkworm and acquaintance with methods of disinfection.
9. **Mid semester examination**
10. Species of Lac insect. Morphology, biology and secretion of lac. Host plants of lac insect, lac production – Seed lac –Button lac- Shellac. Lac products – Uses of lac.
11. Minor productive insects - Cochineal insect, Gall insect, Food and Medicinal value of insects, Aesthetic and Scientific value of insects.
12. Nematology - Introduction – Position of nematodes in animal kingdom. Importance of plant parasitic and entomophilic nematodes. Elementary knowledge on morphology of nematode – cuticle, segmentation, cephalic regions.
13. Elementary knowledge on alimentary, excretory, reproductive, nervous systems and sense organs.
14. Biology and ecology of important plant parasitic nematodes - *Meloidogyne*, *Heterodera*,

*Globodera*, *Tylenchulus*, *Pratylenchus*, *Rotylenchulus*, *Radopholus*, *Aphelenchoide*, and *Ditylenchus*. Damages of nematodes in major crops.

15. Extraction of nematodes - Soil and root sampling, Cobb's sieving method, Baermann funnel technique and modified Baermann funnel technique, sugar flotation technique, cysts by conical flask technique, fenwick can method and Incubation and Blender technique.
16. Observing the life stages of *Meloidogyne*.
17. **Practical examination.**

## REFERENCE BOOKS

1. Atwal, A.S. 2006. The World of the Honey Bee. Kalyani Publ., New Delhi. 257p.
2. Dandin, S.B., J.Jayaswal and K. Giridhar. 2003. Hand book of Sericulture Technologies. Central Silk Board, Bangalore, 287 p.
3. David, B.V. and V.V. Ramamurthy. 2010. Elements of Economic Entomology (Revised edition). Namurtha Publications, Chennai. 624 p.
4. Hariprasad, Y, R.Veeravel and R. Kannan. 2006. Basics of Plant Nematodes. Sowmi Publications. Chidambaram. 205p.
5. Jonathan, E.I. 2010. Fundamentals of Plant Nematology, Devi Publications, Triruchirapalli. P. 232.

## SAC 214 MANURES, FERTILIZERS AND AGRO-CHEMICALS (2+1)

### OBJECTIVE

To impart knowledge on preparation of organic manures and fertilizers and their usage in Agriculture. The course also provides understanding about the agrochemicals used for crop protection and production.

### THEORY

#### Unit I:

Introduction – definition and differences between manures and fertilizers – classification of manures– importance of manures in soil fertility management. Bulky organic manures – preparation of Farm Yard Manure (FYM) – methods of collection and storage-Losses of nutrients from FYM during collection and storage – ways to minimize these losses.

Compost and composting – methods of composting -Methods of preparation of rural and urban compost – mechanical compost plants – their advantages over conventional composting – vermicomposting. Green manures – classification with examples – advantages and limitations of green manuring and green leaf manuring. Definitions of penning, sewage, sullage, sludge and poudrette – concentrated organic manures – oil cakes, blood meal, bone meal, horn meal, fish meal, meat meal and guano. Biogas plant – principles of operation and its advantages

#### Unit II

Commercial fertilizers – classification– manufacturing process and properties of major nitrogenous fertilizers viz., ammonia, ammonium sulphate, urea and calcium ammonium nitrate. Phosphatic fertilizers – rock phosphate – uses – occurrence, types and properties – manufacturing process and properties of phosphatic fertilizers viz., Single Super Phosphate (SSP), Triple Super Phosphate (TSP) and basic slag. Potassic fertilizers – mineral sources – manufacturing process and properties of Muriate of Potash (MOP) and Sulphate of Potash (SOP).

#### Unit III

Complex fertilizers – preparation and properties of nitrophosphates, ammonium phosphates and urea ammonium phosphates. Preparation and properties of ammonium sulphate nitrate, ammonium poly phosphates and NPK complex fertilizers. Mixed fertilizers and amendments – advantages and disadvantages over straight fertilizers – compatibility of fertilizers and reactions of NPK fertilizers in soil. Secondary and micronutrient fertilizers – different sources of these nutrients and their contents – conditions leading to their deficiency. Fertilizer Control Order (FCO) – its importance and regulations – specifications and fertilizer storage standards of important fertilizers. Biofertilizers – use of biofertilizers in agriculture and their advantages

#### Unit IV

Agrochemicals – classification based on their use with examples – classification of insecticides based on their chemical nature with examples – botanical insecticides – brief mention about essential oils. Natural pyrethrum – discovery – sources – chemistry – extraction and properties; Neem and its products – extraction – mode of action of neem based products. Brief note on synthetic pyrethroids. Synthetic organic insecticides – cyclodienes – Diels-Alders reaction – structure, properties and uses of endosulfan. Organo-phosphorus insecticides – discovery – advantages – classification – mode of action – structure, properties and uses of dichlorvos (DDVP). Thiophosphoric acid derivatives – thio and thiono isomers – structure and activity relationships of thiophosphoric acid derivatives – structure, properties and uses of methyl parathion. Dithiophosphoric acid derivatives – structure, properties and uses of phorate

and malathion. Carbamate insecticides – chemistry, discovery and mode of action, structure, properties and uses of carbofuran

### Unit V

Fungicides – definition – classification – structure, properties and uses of copper oxy chloride, zineb, carbandazim, captan, carboxin and tridemorph. Herbicides – classification - mode of action of herbicides – respiration, mitochondrial activity, photosynthesis, protein and nucleic acid metabolism. Structure, properties and uses of 2,4-dichloro phenoxy acetic acid (2,4-D), atrazine, butachlor, glyphosate and benthocarb

Chemistry of growth regulators-Classification-structure, properties and uses.

### THEORY LECTURE SCHEDULE

1. Introduction – definition and differences between manures and fertilizers – classification of manures (bulky and concentrated) with suitable examples – importance of manures in soil fertility management
2. Bulky organic manures – preparation of Farm Yard Manure (FYM) – methods of collection and storage. Losses of nutrients from FYM during collection and storage – ways to minimize these losses
3. Compost and composting – different methods of composting indicating the starters and raw materials. Methods of preparation of rural and urban compost – mechanical compost plants – their advantages over conventional composting .
4. Vermicompost-raw materials, earthworm types, compost preparation
5. Green manures – classification with examples – advantages and limitations of green manuring and green leaf manuring
6. Definitions of penning, sewage, sullage, sludge and poudrette
7. concentrated organic manures – oil cakes, blood meal, bone meal, horn meal, fish meal, meat meal and guano
8. Biogas plant – principles of operation and its advantages. Use of human waste in as manure.
9. Commercial fertilizers – classification with examples – nitrogenous fertilizers – manufacturing process and properties of major nitrogenous fertilizers *viz.*, ammonia
10. Manufacturing process and properties of major nitrogenous fertilizers *viz.*, ammonium sulphate, urea and calcium ammonium nitrate
11. Phosphatic fertilizers – rock phosphate – uses – occurrence, types and properties – manufacturing process and properties of phosphatic fertilizers *viz.*, Single Super Phosphate (SSP), Triple Super Phosphate (TSP) and basic slag
12. Potassic fertilizers – mineral sources – manufacturing process and properties of Muriate of Potash (MOP) and Sulphate of Potash (SOP)
13. Complex fertilizers – preparation and properties of nitrophosphates, ammonium phosphates and urea ammonium phosphates
14. Preparation and properties of ammonium sulphate nitrate, ammonium poly phosphates and NPK complex fertilizers
15. Mixed fertilizers and amendments – advantages and disadvantages over straight fertilizers – compatibility of fertilizers and reactions of NPK fertilizers in soil
16. Secondary and micronutrient fertilizers – different sources of these nutrients and their contents – conditions leading to their deficiency.
17. preparation of micronutrient fortified organic manures and micronutrient chelates.
18. Mid Semester Examination
19. Fertilizer Control Order (FCO) – its importance and regulations – specifications and fertilizer storage standards of important fertilizers
20. Biofertilizers – use of biofertilizers in agriculture and their advantages
21. Outlines of organic chemistry – theory of vitalism – classification of organic compounds based on their chemical nature / structure with examples
22. Agrochemicals – classification based on their use with examples – classification of insecticides based on their chemical nature with examples
23. Botanical insecticides – brief mention about essential oils. Natural pyrethrum – discovery – sources – chemistry – extraction and properties; Neem and its products – extraction – mode of action of neem based products
24. Advantages and disadvantages of natural botanical insecticides – brief note on synthetic pyrethroids with examples – their use in agriculture
25. Synthetic organic insecticides – cyclodienes – Diels-Alders reaction – structure, properties and uses of endosulfan
26. Organo-phosphorus insecticides – discovery – advantages – classification – mode of action – structure, properties and uses of dichlorvos (DDVP)
27. Thiophosphoric acid derivatives – thio and thiono isomers – structure and activity relationships of thiophosphoric acid derivatives – structure, properties and uses of methyl parathion
28. Dithiophosphoric acid derivatives – structure, properties and uses of phorate and malathion
29. Carbamate insecticides – chemistry, discovery and mode of action, structure, properties and uses of carbofuran
30. Fungicides – definition – systemic and non systemic – classification of fungicides based on chemical nature with examples – structure, properties and uses of copper oxy chloride and zineb
31. Structure, properties and uses of carbandazim, captan, carboxin and tridemorph
32. Herbicides – classification of herbicides based on chemical nature with examples – selectivity of herbicides – brief note on mode of action of herbicides – respiration, mitochondrial activity, photosynthesis, protein and nucleic acid metabolism

33. Structure, properties and uses of 2,4-dichloro phenoxy acetic acid (2,4-D), atrazine, butachlor, glyphosate and benthocarb
34. Structure, properties and use of growth regulators-IAA, IBA, NAA, CCC, Gibberellin etc.,

### PRACTICAL CLASS OUTLINES

1. Sampling of organic manures, fertilizers and pesticides for chemical analysis
2. Quick tests for identification of important fertilizers – acidic and basic radicals
3. Estimation of total nitrogen in FYM and Urea
4. Estimation of water soluble  $P_2O_5$  in SSP
5. Estimation of potassium in MOP / SOP
6. Estimation of micronutrients by AAS
7. Safe handling and uses of pesticides
8. Study of pesticide formulations and physical tests for different formulations
9. Estimation of acidity and alkalinity of pesticides
10. Estimation of emulsion stability in EC formulation
11. Determination of purity of Phosphamidon by Iodometry
12. Determination of purity of metasystox by acid-base neutralization method
13. Determination of purity of malathion by Iodometry
14. Determination of copper content in copper oxychloride
15. Determination of sulphur content in sulphur fungicides (elemental sulphur)
16. Compatibility of fertilizers with insecticides and fungicides
17. Practical examination

### REFERENCES

1. A World Compendium. 1995. *The Pesticide Manual*. British Crop Production Council, U.K.
2. Nene, Y.L. and Thapliyal, P.N. 1991. *Fungicides in Plant Disease Control*. Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.
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4. Seetharaman, S., Biswas, B.C., Maheswari, S. and Yadav, D.S. 1996. *Hand Book on Fertilizers Usage*. The Fertilizer Association of India, New Delhi.
5. Sreeramulu, U.S. 1991. *Chemistry of Insecticides and Fungicides*. Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi
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7. Handa, S.K. 2004 *Principles of pesticide Chemistry*. Agrobios(India) Jodhpur

## GPB 215 PRINCIPLES AND METHODS OF PLANT BREEDING (2+1)

### OBJECTIVES

1. To impart knowledge on emasculation and pollination techniques of various crops
2. To impart knowledge on application of various genetic principles in crop improvement

### THEORY

#### Unit I: Introduction

Classification of plants, Botanical description, floral biology, emasculation and pollination techniques in cereals, millets, pulses, oilseeds, fibers and plantation crops. Objectives and role of plant breeding - historical perspective – activities in Plant Breeding. Centres of origin – contribution of Vavilov- law of homologous series. Plant genetic resources – importance – germplasm – gene erosion - gene bank - conservation – types of conservation – agencies – quarantine. Modes of reproduction – sexual – asexual - self and cross fertilization – significance of pollination. Self incompatibility – Sterility – male sterility – CMS, GMS, CGMS-inheritance and applications. TGMS, PGMS, Gametocides, Transgenic Male sterility and applications. Apomixis

#### Unit II: Breeding methods of self pollinated crops

Basic biometrics-nature and significance of qualitative and quantitative variation-phenotypic, genotypic and environmental-heritability and genetic advance. Plant introduction – objectives – quarantine - acclimatization – achievements - merits and demerits. Genetic basis of self pollinated crops – Vilmorin principle of progeny selection - Johannsen's pure line theory. Breeding methods for self pollinated crops without involving artificial hybridization: Pure line selection – Mass selection in self pollinated crops – Breeding methods of self pollinated crops involving artificial hybridization: Creating variability in self pollinated crops - Hybridization and selection – objectives types – choice of parents – combining ability - combination breeding and transgressive breeding – Pedigree breeding – Bulk breeding – Single Seed Descent (SSD) method – procedure – application – merits and demerits.

Backcross breeding, multi lines and multi blends - population improvement approach in self-pollinated crops.

### **Unit III: Breeding methods of cross pollinated crops and clonally propagated crops**

Genetic structure of population in cross pollinated crop – Hardy Weinberg law – gene frequencies in random mating population – principles in population improvement. Breeding methods of cross pollinated crops without involving artificial hybridization: Mass selection in cross pollinated crops – Breeding methods of cross pollinated crops involving artificial hybridization: Recurrent selection, Heterosis breeding – procedure – use of male-sterility systems and manual emasculation in hybrid seed production – Synthetics and composites - steps in development of synthetics and composites – achievements – merits and demerits. Genetic characters of asexual reproduction – breeding methods – clonal selection – hybridization and clonal selection – merits and demerits – achievements; Chimeras and its types; Tree breeding – clonal orchards.

### **Unit IV: Special breeding methods**

Polyploidy breeding – classification – induction of polyploidy – diploid x tetraploid and diploid x hexaploid crosses - achievements – limitations. Wide hybridization-history-importance-barriers and techniques for overcoming barriers-utilization. Mutation breeding: mutation – types – mutagens – breeding procedure – applications – achievements – limitations. Somaclonal variation - utilization in crop improvement; *In vitro* selection techniques — Use of doubled haploids in crop improvement. Introduction to markers – morphological – biochemical- DNA markers – uses of marker assisted selection - major genes – merits – demerits – achievements.

### **Unit V: Maintenance breeding**

Types of cultivars – procedure for release of new varieties – stages in seed multiplication – seed certification and TC plants certification. Maintenance Breeding: Breeding for biotic and abiotic stresses; Current trends in Plant Breeding- Marker assisted breeding -Transgenic crops - Varietal protection and geographical indications – DUS. Breeding for pest resistance - mechanisms of resistance; Breeding for disease resistance - mechanisms of resistance; Breeding for Abiotic stress – drought and cold. – mechanisms of resistance; Breeding for Abiotic stress – salinity and alkalinity - mechanisms of resistance; Breeding for quality produce; Ideotype breeding, PPV &FR act, 2001- Plant breeder's right, Farmer's right, Biodiversity act, 2002; Germplasm registration.

## **PRACTICAL**

Observation on reproductive and pollination systems in plants – Alternation of generation and life cycle – Description and drawing of different pollination systems – Mechanisms enforcing self and cross pollination – Morphology of pollen grains – Assessment of pollen fertility and sterility in A, B, and R line – Maintenance of A, B lines. Emasculation technique – Selfing and crossing techniques – Breeder kit – Layout of different trials – Irradiation – dosimetry – Half life period – Procedure for irradiation – Chemical mutagenesis – Molar solution – Procedure for treatment – Calculation of heterosis, PCV, GCV, heritability, genetic advance – genetic divergence – Records maintained – Wild species maintenance and utilization - screening method for specific traits – marker assisted selection.

## **THEORY SCHEDULE**

1. Classification of plants, Botanical description, floral biology, emasculation and pollination techniques in cereals, millets, pulses, oilseeds, fibers and plantation crops.
2. Objectives and role of plant breeding - historical perspective – activities in Plant Breeding.
3. Centres of origin – contribution of Vavilov, Harlan, Zhukovosky – law of homologous series.
4. Plant genetic resources – importance – germplasm – types – activities – gene erosion - gene bank – collection - conservation – types of conservation – agencies – quarantine.
5. Germplasm: evaluation – use of descriptors, documentation, utilization; Agencies – national and international; germplasm exchange – quarantine.
6. Modes of reproduction – sexual – asexual - self and cross fertilization – significance of pollination.
7. Self incompatibility – classifications – mechanisms – application – measures to over come and limitations.
8. Sterility – male sterility – introduction – classification – CMS,GMS,CGMS -inheritance and applications - TGMS, PGMS, Gametocides, Transgenic Male sterility and applications.
9. Apomixis – introduction - classification-applications; Parthenocarpy and its types.
10. Basic biometrics-nature and significance of qualitative and quantitative variation-phenotypic, genotypic and environmental-heritability and genetic advance
11. Plant introduction as a breeding method – types of introduction – objectives – quarantine - acclimatization – achievements - merits and demerits.
12. Genetic basis of self pollinated crops – Vilmorin principle of progeny selection - Johannsen's pure line theory.
13. Breeding methods for self pollinated crops without involving artificial hybridization: Pure line selection – procedure – merits and demerits – achievements; Mass selection in self pollinated crops – procedure - types – comparison of mass and pureline selection – achievements.

14. Breeding methods of self pollinated crops involving artificial hybridization: Creating variability in self pollinated crops - Hybridization and selection – objectives types – choice of parents – combining ability - combination breeding and transgressive breeding – steps in hybridization - kinds of emasculation.
15. Pedigree breeding – procedure – mass pedigree – merits – demerits – achievements; Bulk breeding – procedure – merits – demerits – achievements.
16. Comparison of pedigree and bulk breeding methods. Single Seed Descent (SSD) method – procedure – application – merits and demerits.
- 17. Mid Semester Examination**
18. Backcross breeding – genetic principles – prerequisites – procedures for transferring dominant and recessive genes - merits – demerits – multi lines and multi blends - population improvement approach in self-pollinated crops.
19. Genetic structure of a population in cross pollinated crop – Hardy Weinberg law – gene frequencies in random mating population – principles in population improvement.
20. Breeding methods of cross pollinated crops without involving artificial hybridization: Mass selection in cross pollinated crops – modified mass selection – unit selection – mass selection with progeny testing – half sib family selection – full sib family selection.
21. Breeding methods of cross pollinated crops involving artificial hybridization: Recurrent selection principles – types – merits and demerits - Heterosis breeding – genetic basis – hybrid vigour – estimation of heterosis – inbreeding depression – development of inbreds.
22. Heterosis breeding – procedure – use of male-sterility systems and manual emasculation in hybrid seed production – maintenance of parental lines -types of hybrids – achievements – merits and demerits.
23. Synthetics and composites - steps in development of synthetics and composites – achievements – merits and demerits.
24. Genetic characters of asexual reproduction – breeding methods – clonal selection – hybridization and clonal selection – merits and demerits – achievements; Chimeras and its types; Tree breeding – clonal orchards.
25. Polyploidy breeding – classification – induction of polyploidy – diploid x tetraploid and diploid x hexaploid crosses - achievements – limitations.
26. Wide hybridization-history-importance-barriers and techniques for overcoming barriers-utilization
27. Mutation breeding: mutation – types – mutagens – breeding procedure – applications – achievements – limitations.
28. Somaclonal variation - utilization in crop improvement; *In vitro* selection techniques — Use of doubled haploids in crop improvement.
29. Introduction to markers – morphological – biochemical- DNA markers – uses of marker assisted selection - major genes – merits – demerits – achievements.
30. Types of cultivars – procedure for release of new varieties – stages in seed multiplication – seed certification and TC plants certification.
31. Maintenance Breeding: General seed production techniques – steps in nucleus and breeder seed production – varietal rundown and renovation.
32. Breeding for biotic and abiotic stresses; Current trends in Plant Breeding - Marker assisted breeding -Transgenic crops - Varietal protection and geographical indications – DUS.
33. Breeding for pest resistance - mechanisms of resistance; Breeding for disease resistance - mechanisms of resistance; Breeding for Abiotic stress – drought and cold. – mechanisms of resistance; Breeding for Abiotic stress – salinity and alkalinity
34. Breeding for quality produce; Ideotype breeding, PPV &FR act, 2001- Plant breeders' right, Farmers right, Biodiversity act, 2002; Germplasm registration.

## **PRACTICAL SCHEDULE**

1. Emasculation and pollination techniques in rice, maize, pulses, castor and cotton.
2. Pollination and reproduction in plants - Alternation of generation and life cycle.
3. Description and drawing different pollination systems - Mechanisms enforcing self and cross pollination in crops; Pollen morphology - Exine structure of different crops. Fertility and sterility in A, B, R and TGMS lines.
4. Breeder kit and its components – uses; Basic steps of selfing and crossing techniques.
5. Emasculation and pollination techniques in field crops.
6. Emasculation and pollination techniques in horticultural crops.
7. Studies on segregating generations and maintenance of records.
8. Maintenance of A, B and R line and TGMS lines - Hybrid seed production techniques
9. Estimation of heterosis.
10. Induction of polyploidy using colchicine.

11. Studies on different wild species in crop plants and wide hybridization.
12. Irradiation - dosimetry - half life period - procedure for irradiation of seeds and planting materials. Chemical mutagenesis - molar solution preparation - procedure for chemical mutagenesis of seeds and planting materials.
13. Calculation of PCV, GCV, heritability, genetic advance, genetic divergence
14. Layout of different yield trials - Observing the experimental plots; Visit to nucleus and breeder seed production plots.
15. Screening methods – laboratory and field – for biotic and abiotic stresses.
16. Procedure for marker assisted selection.
17. **Final Practical Examination.**

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2. Daniel Sundararaj, G. Thulasidas and M. Stephen Dorairaj. 1997. Introduction to Cytogenetics and Plant Breeding. Popular Book Depot. Chennai – 15.
3. Phundhan Singh. 2001. Essentials of plant breeding, Kalyani publishers, New Delhi.
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## HOR 216 PRODUCTION TECHNOLOGY OF FRUITS AND PLANTATION CROPS (2+1)

### OBJECTIVES

The students will be educated on the cultivation aspects of major fruit crops grown in tropical, sub-tropical and temperate regions and about the plantation crops.

### THEORY

#### Unit I: Importance of fruit crops & their cropping systems

Scope and importance of fruits- classification of fruits – area - production and export potential – nutritive value, planting and cropping systems in fruit crops- Sylvi pastures- Multi tire cropping system - special operations in fruit crops- principles of canopy management and growth regulation - importance of GAP and organic fruit production

#### Unit II: Crop production technologies in tropical fruit crops

Climate and soil requirements-varieties-propagation-planting density and systems-cropping systems-after care- training and pruning- water, nutrient and weed management- special horticultural techniques-plant growth regulation- important disorders – maturity indices and harvest- post harvest management of following crops:

Mango, banana, grapes, citrus (sweet orange, mandarin, acid lime), papaya, sapota, guava

#### Unit III: Crop production techniques in subtropical and temperate fruit crops

Climate and soil requirements-varieties-propagation-planting density and systems-cropping systems-after care- training and pruning- water, nutrient and weed management- special horticultural techniques-plant growth regulation- important disorders – maturity indices and harvest- post harvest management of following crops:

Pineapple, jack, pomegranate, custard apple, aonla, apple, pear, plum, peach.

#### Unit IV: Importance of plantation crops & their cropping systems

Scope and importance of plantation crops – area and production - export potentials –planting and cropping systems in plantation crops- principles of canopy management and growth regulation - importance of GAP and organic plantation production

#### Unit V: Crop production techniques in the plantation crops

Climate and soil requirements-varieties-propagation - planting density and systems of planting - cropping systems - after care - training and pruning - water, nutrient and weed management - shade management – intercropping - maturity indices and harvest - post harvest management and processing of following crops:

Tea, coffee, rubber, cocoa, cashew, coconut, arecanut, oil palm and palmyrah

### PRACTICAL

Propagation techniques, selection of planting material, varieties, important practices for the fruit crops : mango, banana, grapes, citrus (sweet orange, mandarin, acid lime), papaya, sapota, guava- visit to commercial orchards located at different horticultural cropping zones, Post harvest handling of important tropical crops.

Propagation techniques, selection of planting material, varieties, important practices for the plantation crops: Tea, coffee, rubber, cocoa, cashew, coconut, arecanut, oilpalm.

Study of post harvest handling of important plantation crops and visit to plantation and processing units.

### **THEORY SCHEDULE**

1. Scope and importance of fruits – Global and national scenario of fruits - classification of fruits - nutritive value – area, production and export potential.
2. Planting and cropping systems in fruit crops - Sylvi pastures- Multi tire cropping system -special operations in fruit crops- principles of canopy management and growth regulation
3. Importance of GAP and organic fruit production
4. Climate and soil -varieties- propagation methods- planting and cropping systems-after care- training and pruning- water, nutrient and weed management- special horticultural techniques - plant growth regulation- important disorders – maturity indices and harvest- post harvest management of mango
5. –do--- banana
6. –do--- grapes
7. –do--- citrus(sweet orange, mandarin and acid lime)
8. –do--- papaya
9. –do--- sapota
10. –do--- guava
11. –do--- pineapple
12. –do--- jack and pomegranate
13. –do--- custard apple and aonla
14. –do--- apple
15. –do--- pear
16. –do--- plum and peach

### **17. Mid Semester Examination**

18. Scope and importance – Status of National and International scenario – Area - production- productivity- export potential - Importance of GAP and Organic production of plantation crops - Planting and cropping systems – principles of canopy management and growth regulation
19. Production technology of Coconut – soil, climate, varieties, nursery and planting
20. Production technology of Coconut -Water, weed and nutrient management, intercropping, harvest and post harvest handling
21. Production technology of Arecanut- soil, climate, varieties, nursery and planting, water, weed and nutrient management, intercropping, harvest and post harvest handling
22. Production technology of oil palm - soil, climate, varieties, nursery and planting, training and pruning, water, weed and nutrient management, intercropping, harvest, post harvest handling and processing
23. Production technology of Tea - soil, climate, varieties, nursery and planting, training and pruning
24. Production technology of Tea - Water, weed and nutrient management - canopy management and shade regulation – harvest, processing, grading, packing and storage of Tea
25. Production technology of Coffee - soil, climate, varieties, nursery and planting, training and pruning
26. Production technology of Coffee - Water, weed and nutrient management - canopy management and shade regulation – intercropping, harvest, processing, grading, packing and storage of Coffee
27. Production technology of Rubber - soil, climate, varieties, nursery and planting, training and pruning
28. Production technology of Rubber - Water, weed and nutrient management - canopy management and shade regulation – intercropping, harvest, processing, grading, packing and storage of Rubber
29. Production technology of Cocoa - soil, climate, varieties, nursery and planting, training and pruning
30. Production technology of Cocoa - Water, weed and nutrient management - canopy management and shade regulation –harvest, processing, grading, packing and storage of Cocoa
31. Production technology of Cashew - soil, climate, varieties, nursery and planting, training and pruning
32. Production technology of Cashew - Water, weed and nutrient management - canopy management – intercropping, harvest, processing, grading, packing and storage of Cashew
33. Production technology of Palmyrah - soil, climate, varieties, nursery, planting, nutrient management - canopy management – harvest and processing
34. Value addition in plantation crops

### **PRACTICAL SCHEDULE**

1. Mango - varietal identification, selection of planting material and important cultural practices viz., training and pruning
2. Sapota - varietal identification, selection of planting material and important cultural practices viz., training and pruning
3. Banana – varietal identification, selection of planting material and important inter - cultural practices viz., desuckering and propping
4. Grapes - varietal identification and sub groups in citrus and important cultural practices viz., training and pruning practices



5. Citrus - varietal identification and sub groups in citrus and important cultural practices viz., training and pruning practices
6. Papaya and guava - varietal identification and important cultural practices
7. Visit to commercial orchards located at different horticultural cropping zones
8. Post harvest handling practices of important tropical fruit crops.
9. Tea – identification of species and varieties – nursery practices – training and pruning - processing
10. Coffee – identification of species and varieties – nursery practices – training and pruning - processing
11. Rubber – identification of varieties – Bud wood nursery practices – training- processing
12. Cocoa – identification of types– clonal nursery practices – training and pruning - processing
13. Cashew – identification of varieties - propagation techniques – grafting - top working – processing
14. Coconut - identification of varieties – mother palm and seed nut selection – nursery practices– management of nutrient deficiencies – processing
15. Arecanut and oil palm- Identification of varieties – mother palm and seed nut selection – nursery practices– management of nutrient deficiencies – processing
16. Visit to commercial plantations and processing industries
- 17. Final Practical Examination**

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## AEC 217 PRODUCTION ECONOMICS AND FARM MANAGEMENT (1+1)

### OBJECTIVES

The objective of this course is to provide applied and practical understanding of production economics and farm management techniques with emphasis on its economic analysis.

### THEORY

#### Unit I Nature and Scope

Production economics : Meaning - definition – nature and scope. Farm Management: Definition - objectives of farm management - Production economics Vs Farm management. Farm management decisions - decision making process - scope of farm management - types and systems of farming : Types - specialized and diversified-mixed – systems of farming – peasant farming – state farming – capitalistic – collective- co-operative farming.

#### Unit II Factor-Product Relationship

Factor-Product relationship: Meaning - Agricultural production function: Meaning – Definition- laws of returns: increasing, constant and decreasing returns - classical production function and three stages of production – elasticity of production. Types/Forms of production functions - linear, cobb-douglas and quadratic. Cost concepts and cost curves: total, average and marginal cost – economics of scale - determination of optimum input and output - physical and economic optimum.

#### Unit III Factor- Factor Relationship

Factor-factor relationship : Meaning- isoquant – definition and types - isoquant map - marginal rate of technical substitution - factor intensity - isocline- ridge line - returns to scale – elasticity of factor substitution- iso-cost line – principle of factor substitution and least cost combination of inputs – expansion path - effect of input price changes on the least cost combination.

#### Unit IV Product-Product Relationship

Product-product relationship: Meaning – production possibility curve – marginal rate of product transformation. Enterprise relationship: joint products – complementary – supplementary – competitive products – iso-revenue line – optimum combination of products – principle of equi-marginal returns – principle of opportunity cost.

#### Unit V Farm Planning and Budgeting

Farm planning: importance – characteristics of good farm plan – farm planning procedure. Budgeting: Definition and types – complete budgeting – partial budgeting – enterprise budgeting – cash flow budgeting – limitations of budgeting. Linear programming: Assumptions – linear

programming model – graphical solution - advantages and limitations. Risk and uncertainty: Definition – types of risk and uncertainty – safeguards against risk and uncertainty.

## **PRACTICAL**

Problems on factor-product relationship- determination of least-cost combination- determination of optimum product combination-computation of cost concepts- cost of cultivation and cost of production of agricultural crops, horticultural and livestock products - depreciation- methods of calculation of depreciation- Farm records and accounts – analysis of farm records and accounts - farm inventory analysis – net worth statement – profit and loss statement – break-even analysis — preparation of complete and partial budgets - preparation of farm plan – graphical solution to linear programming problem.

## **THEORY SCHEDULE**

1. Production economics: Meaning - definition – nature and scope. Farm Management: Definition - objectives of farm management - Production economics Vs Farm management
2. Farm management decisions - decision making process - scope of farm management
3. Types and systems of farming: Types - specialized and diversified-mixed – systems of farming – peasant farming – state farming – capitalistic – collective- co-operative farming.
4. Factor-Product relationship : Meaning - Agricultural Production Function : Meaning – definition- laws of returns: increasing, constant and decreasing returns
5. Classical production function and three stages of production – elasticity of production
6. Types of Production functions: Linear, Cobb-Douglas and quadratic
7. Cost concepts and cost curves: total, average and marginal cost concepts and curves, economics of scale.
8. Determination of optimum input and output: input approach and output approach - physical and economic optimum.
9. **Mid semester examination**
10. Factor-factor relationship: Meaning- isoquant – definition and types - isoquant map - marginal rate of technical substitution - factor intensity – isoclines – ridge line
11. Returns to scale – elasticity of factor substitution- iso-cost line – principle of factor substitution and least cost combination of inputs – expansion path - effect of input price changes on the least cost combination
12. Product-product relationship: Meaning – production possibility curve – marginal rate of product transformation. Enterprise relationship: joint products – complementary – supplementary – competitive products
13. Iso-revenue line – optimum combination of products – principle of equi-marginal returns – Principle of opportunity cost
14. Farm planning: Importance – characteristics of good farm plan – farm planning procedure
15. Budgeting : Definition and types – complete budgeting – partial budgeting –enterprise budgeting – cash flow budgeting – limitations of budgeting
16. Linear programming : Assumptions – linear programming model – graphical solution - advantages and limitations
17. Risk and uncertainty: Definition – types of risk and uncertainty – safeguards against risk and uncertainty

## **PRACTICAL SCHEDULE**

1. Estimation of optimum input – output combination.
2. Determination of least-cost combination
3. Determination of optimum product combination
4. Computation of cost concepts- cost of cultivation and cost of production of agricultural crops
5. Cost of cultivation and production of perennial crops/ horticultural crops.
6. Cost of production of livestock products
7. Depreciation: methods of calculating depreciation
8. Visit to a farm (government/private/corporate) to study the layout and organization
9. Farm records and accounts : Usefulness, types of farm records–farm production records–farm financial records
10. Visit to a private agricultural farm to collect information on farm business
11. Farm inventory analysis: Examination of assets – valuation of assets by different methods
12. Preparation and analysis of net worth statement and profit and loss statement
13. Estimation of break-even analysis
14. Preparation of complete budget and partial budgets
15. Preparation of farm plan
16. Graphical solution to linear programming problem
17. **Final Practical Examination**

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## AEX 218 DIMENSIONS OF AGRICULTURAL EXTENSION (1+1)

### OBJECTIVES

- To learn the concepts related with the Agricultural Extension and Rural Development.
- To know the past and present programmes in agriculture and rural development.
- To know the functioning of various development agencies.

### THEORY

#### Unit I: MEANING AND IMPORTANCE OF EXTENSION EDUCATION

Extension – meaning – Agricultural Extension – definition, scope, Education – concepts, types. Extension Educational Process – difference between formal education and extension education. Extension Education – objectives, principles and philosophy of extension-steps in extension -teaching, teaching-learning process.

#### Unit II: RURAL DEVELOPMENT IN INDIA

Rural Development – meaning – definition, concept, objectives, importance and problems in Rural development. Rural Development in India – Community Development and Agricultural Extension Service in India – Stages of Rural Development – Pre-independence era, Post independence era.

#### Unit III: RURAL DEVELOPMENT PROGRAMMES AND EXTENSION SYSTEMS IN INDIA

Integrated Rural Development Programmes – Social Justices and Poverty alleviation programmes – Integrated Tribal Development Agency – Rural Youth Programmes. History of extension systems – IADP, HYVP, T&V, BBES – Extension and Development Programmes viz., ATMA, ATIC, IVLP, WDP.

#### Unit IV: UNDERSTANDING PANCHAYAT RAJ SYSTEM IN INDIA

Panchayat Raj System – Meaning of Democratic Decentralisation and Panchayat Raj – Three tiers of Panchayat Raj system – Powers, Functions and Organizational setup.

#### Unit V: GENDER DIMENSIONS IN AGRICULTURE

Gender Dimensions – Women in Agriculture – Women Development Programmes – DWCRA – RMK – ICDS – MSY-TANWA.

### PRACTICAL

Visit – Village / Gram Panchayat – BDO – JDA's office-AO/ADA office - Seed Farm Unit - DRDA-NGO-ATMA village – SHG - Nationalized Bank - PACB - District Collectorate-Visit to village-study rural development programmes-identify problems in agriculture-develop extension strategies.

### THEORY SCHEDULE

1. Extension-Meaning-Agricultural Extension-Definition, scope of Agricultural Extension
2. Education-Definition-Extension Education Process-Difference between formal education and Extension Education-Teaching Learning Process.
3. Extension Education-Objectives, principles and philosophy of Extension
4. Rural Development-Meaning-Definition, concept, objectives, importance and problems in rural development.
5. Rural Development in India-Community Development and Agricultural Extension Service in India-Stages of Rural Development.
6. IRDP and other poverty alleviation programmes viz., SGSY, PMEY.
7. Extension and development programmes like ATMA, ATIC, IVLP, WDP.
8. Integrated Tribal Development Agency and Rural Youth Programmes.
9. **Mid Semester Examination**
10. History of Extension Systems-IADP, HYVP, T&V, BBES and re-organized two tier extension system.
11. Panchayat Raj system-Meaning-Democratic Decentralisation
12. Need for Democratic Decentralisation-philosophy and objectives of Democratic Decentralisation
13. Three tiers of Panchayat Raj system-Powers, Functions and Organizational set up.

14. Gender Dimensions-mainstreaming gender in Agriculture for developmental programmes
15. Importance and role of women in agriculture
16. Women development programmes in the context of rural development.
17. New dimensions added to women welfare-National mission for women for holistic development of women.

### **PRACTICAL SCHEDULE**

1. Visit to a village/Gram panchayat union office to study the organizational setup and programmes implemented.
2. Visit to Block Development Office to study organizational set up and programmes implemented.
3. Visit to JDA's office to understand the reorganized extension system, organizational setup and functions of State Department of Agriculture at district level.
4. Visit to AO office to study about organizational setup and its functions
5. Visit to block level ADA office to study organizational setup and the extension programmes implemented at block level.
6. Visit to Seed Farm to study organizational setup and their programme.
7. Visit to District Rural Development Agency (DRDA) to study organizational setup and the rural development schemes implemented.
8. Visit to NGO to study about their role in rural development activities.
9. Visit to ATMA village to study the ATMA projects implemented in the village.
10. Visit to an NGO to study the women development programme activities.
11. Visit to Agriculture Marketing society to study their activities.
12. Visit to a village to study rural development programmes implemented in the village
13. Visit to a village to identify the agricultural problems.
14. Visit to a village to develop extension strategies to solve the problems identified.
15. Study the activities of SHGs and their extension approaches.
16. Visit to Nationalized Bank to study about functions and its activities
17. Visit to Primary Agricultural Co-operative Bank to study about functions and its activities

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## **AHS 219 LIVESTOCK AND POULTRY PRODUCTION (2+1)**

### **OBJECTIVES**

To gain current technical knowledge in the field of livestock and poultry production and thereby enabling them to apply their technical brilliance at field level. To acquire hands on training about livestock and poultry based farming, preparation of dairy products .To gain latest technology of livestock industries so as to acquire entrepreneurial attitude among the students.

### **THEORY**

#### **Unit – I Introduction to livestock and Poultry production**

Introduction – Significance of livestock in Agriculture and Indian economy – Different Livestock development programs of Government of India - common nomenclatures used in Animal Husbandry practices – various systems of livestock rearing – Record keeping - space requirement for different species of livestock and poultry

#### **Unit – II Management of Cattle**

Classification of breeds – Breeds of white and black cattle – Sindhi, Kangayam, Umbalacherry, Jersey, Holstein Friesian, Murrah and Surti – Selection of site for housing – Systems of housing – Single row, double row – Oestrous cycle and Artificial Insemination –Care and management of new born calf, heifers, pregnant and lactating animals – Classification of feed - ration – balanced ration – Importance and qualities of green fodder – Disease control measures in cattle.

#### **Unit – III Management of Sheep, Goat and Pigs**

Classification of sheep and goat breeds – Care and Management of Kid and Lamb – steaming up and flushing– Disease control measures in sheep and goats– common breeds of exotic pig – Care and management of piglets – control measures of pig diseases.

#### **Unit – IV Poultry Management**

Classification of breeds –Housing management – Deep litter Vs Cage system – Brooding management – litter management –management of broiler and layers –feed conversion ratio - Disease control measures in poultry.

#### **Unit – V Livestock Products Technology**

Importance of livestock and poultry products – clean milk production – Pasteurization of milk – composition and nutritive value of milk – nutritive value of meat of sheep, goat, pig, poultry and egg.

#### **PRACTICALS**

Study of external parts of cattle - Identification of livestock – Common methods of restraining - Disbudding - Ageing – Design of cattle shed -Determination of specific gravity of milk– Demonstration and estimation of fat percentage and total solids in milk - Demonstration of cream separation - Identification of feed and fodder – Economics of Dairy farming - Brooder management – Dressing of chicken – Economics of broiler production - Visit to Dairy plant, layer and broiler farms.

#### **THEORY LECTURE SCHEDULE**

1. Introduction to Livestock and Poultry Industry
2. Different Livestock development programs of Government of India
3. Common nomenclatures used in Animal Husbandry practices.
4. Systems of Livestock rearing – record keeping
5. Space requirement for different species of Livestock and Poultry
6. Introduction and classification of different breeds of white and black cattle
7. Selection of site for dairy farm and systems of housing
8. Introduction to Estrus cycle – Artificial Insemination
9. Care and management of calf
10. Care and management of heifers
11. Care and management of pregnant and lactating cows.
12. Classification of feed – Ration – Balanced ration
13. Importance of Green fodder – Qualities of good fodder
14. Disease control measures in Cattle
15. Introduction and Classification of sheep and goat breeds
16. Care and management of kid and lamb
17. Mid-term examination.
18. Steaming up and flushing – Disease control measures of sheep and goat.
19. Common breeds of exotic pig
20. Care and management of piglets
21. Disease control measures of pig
22. Introduction to poultry production
23. Classification of breeds of poultry
24. Housing management – Deep litter Vs Cage system in poultry.
25. Brooding management in poultry.
26. Litter management in poultry farm
27. Management of broilers.
28. Management of layers.
29. Feed conversion ratio and disease control measures in poultry production.
30. Introduction and importance of Livestock and poultry products.
31. Clean milk production.
32. Pasteurization of milk.
33. Composition and nutritive value of milk
34. Nutritive value of meat of sheep, goat, pig., poultry meat and egg

#### **PRACTICAL SCHEDULE**

1. Study of external parts of livestock and poultry
2. Identification of livestock
3. Common methods of restraining
4. Disbudding
5. Ageing of cattle
6. Design of Cattle shed
7. Selection of dairy cow
8. Determination of specific gravity in milk.
9. Fat percentage and total solids in cows milk.
10. Demonstration of cream separation
11. Ice cream making

12. Identification of feed and fodder
13. Economics of Dairy farming
14. Brooder management.
15. Dressing of chicken
16. Economics of broiler production, Visit to Dairy plant, layer and broiler farms.
17. Practical Examination

#### **REFERENCES:**

1. Amarjeet Singh, 2008. Animal Husbandry, Rajat Publications, New Delhi.
2. Ashok kumar, 2006. Animal Husbandry, Discovery Publishing House, New Delhi.
3. Banerjee, G.C. 2010. The Text Book of Animal Husbandry, Oxford Book Company, Kolkata.
4. Carmen R. Parkhurst and George J. Mountney, 2002. Poultry Meat and Egg Production, CBS Publishers and Distributors, New Delhi - 2
5. Dairy India Year Book 2007. A-25, Periyadarshini Vihar, New Delhi.
6. ICAR, 2007. A Hand Book of Animal Husbandry

### **SEMESTER – IV**

#### **AGR 221 CROP PRODUCTION (0+1)**

#### **OBJECTIVES**

- Participatory learning of the practice of raising any garden land crop (maize / sorghum / pearl millet / finger millet / cotton / sunflower / sesame)
- He / she will do all field operations in the allotted land from field preparation to harvest and processing.

#### **PRACTICAL SCHEDULE FOR IRRIGATED DRY CROP**

- Ecosystem - Climate and weather - Seasons and varieties of Tamil Nadu
- Selection of field - Main field preparation - seed treatment - Application of manures and fertilizers - Sowing - Weed management and practicing pre- emergence application of herbicides - Thinning and gap filling - Estimation of plant population - Top dressing - Weed management - Water management - Pest management - Observation on nutrient and weeds - Recording growth, yield attributes and yield
- Harvesting, threshing and cleaning the produce - Cost of cultivation and economics

#### **PRACTICAL SCHEDULE**

1. Study of ecosystems, climate, weather, seasons and varieties of Tamil Nadu
2. Selection of field for cultivation.
3. Acquiring skill in seed treatment practices.
4. Study and Practice of main field preparation.
5. Practicing of application of manures and fertilizers.
6. Practicing sowing and acquiring skill in pre-emergence application of herbicides.
7. Estimation of plant population and acquiring skill in gap filling and thinning.
8. Working out LAI and DMP.
9. **Mid-Semester Examination**
10. Observation on nutritional deficiency symptoms and corrective measures.
11. Study of weeds and weed management.
12. Recording growth parameters.
13. Assessing dry matter production and study of water management practices.
14. Observation of insect pests and diseases and their management and estimation of yield and yield parameters.
15. Harvesting, threshing and cleaning of the produce.
16. Working out cost of cultivation and economics.
17. **Practical Examination**

#### **REFERENCES**

1. Chidda Singh. 2010 Modern techniques of raising field crops. Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi.
2. Crop Production Guide. 2005. Directorate of Agriculture, Chennai and Tamil Nadu Agricultural University, Coimbatore.

## AGR 222: AGRONOMY OF FIELD CROPS –II (2+1)

### OBJECTIVES

This course is designed to study the importance, origin, soil, climate, cultural practices and post harvest technology of sugars, fibres, forages, green manures, tubers and narcotics as listed below.

### THEORY

#### Unit – I: Sugar crops

Sugar crops: Sugarcane, Sugar beet and sweet sorghum - Origin, geographic distribution, economic importance, soil and climatic requirement, varieties, cultural practices, yield.

#### Unit – II: Major and minor fibre crops

Fibre crops: Cotton, Jute and Mesta - Origin, geographic distribution, economic importance, soil and climatic requirement, varieties, cultural practices, yield.

#### Unit – III: Forage crops

Forage Crops: Fodder Sorghum, Maize, Pearl millet, Guinea grass, Cumbu Napier grass, Water grass, Buffalo grass, Elephant grass, Kolukkattai grass, Lucerne, Berseem, Desmanthus, Stylosanthus and Cowpea - Economic importance, soil and climatic requirement, varieties, cultural practices and yield.

#### Unit – IV: Green manures

Green Manure crops: Daincha, Sunnhemp Sesbania, Glyricidia, Kolingi- Origin, geographic distribution, economic importance, soil and climatic requirement, Varieties, cultural practices, yield.

#### Unit-V: Tuber crops and Narcotics

Tuber crops-Potato, sweet potato, tapioca and turmeric,  
Narcotics-Tobacco and betel vine,

### PRACTICAL

Identification of sugar, fibre, forage and narcotics - nursery preparation and management for sugarcane and tobacco – main field preparation; Seed treatment techniques - Sowing and manuring – Seeding equipment's - Estimation of population – After cultivation practices - Study of growth and yield parameters and yield estimation, harvesting of above crops; Fodder preservation techniques - Silage and hay making, Cost and returns – Visit to institutes and industries – Farmers' fields.

### THEORY LECTURE SCHEDULE

1. Introduction – importance of sugar crops, fibres, tuber crops narcotics and green manures.
2. Area, production and productivity of sugar crops (sugarcane, sugar beet and sweet sorghum) in India and Tamil Nadu.
3. Sugarcane - Origin, geographical distribution, economic importance, soil and climatic requirements.
4. Sugarcane - Varieties, main field preparation-preparation of setts for planting -cultural practices and yield.
5. Sugarcane – Crop logging, maturity and ripening, sugar and gur manufacture - Value addition and byproduct utilization.
6. Sugar beet– Origin, geographical distribution, economic importance, soil and climatic requirements, varieties, cultural practices, yield and by product utilization.
7. Sweet Sorghum - Origin, geographical distribution, economic importance, soil and climatic requirements, varieties, cultural practices, yield and by product utilization.
8. Fibre crops – Cotton - Origin, geographical distribution, economic importance.
9. Cotton- soil and climatic requirements, cultural practices, yield and quality parameters.
10. Rainfed Cotton, Rice fallow Cotton and transgenic cotton.
11. Jute - Origin, geographical distribution, economic importance.
12. Jute- soil and climatic requirements, varieties, cultural practices and yield.
13. Mesta - Origin, geographical distribution, economic importance.
14. Mesta- soil and climatic requirements, varieties, cultural practices and yield.
15. Sunnhemp - Origin, geographical distribution, economic importance.
16. Sunnhemp-soil and climatic requirements, varieties, cultural practices and yield.
17. Forage crops - Cumbu Napier Hybrid grass: Economic importance, soil and climatic requirement, varieties, cultural practices and yield.
18. **Mid-semester Examination**
19. Forage crops - Guinea grass: Economic importance, soil and climatic requirement, varieties, cultural practices and yield.
20. Forage crops – Fodder Sorghum, Maize, Oats and Cowpea: Economic importance, soil and climatic requirement, varieties, cultural practices and yield.
21. Forage crops – Cenchrus and Lucerne: Economic importance, soil and climatic requirement, varieties, cultural practices and yield.

22. Forage crops - Hedge lucerne: Economic importance, soil and climatic requirement, varieties, cultural practices and yield.
23. Berseem and Desmodium Economic importance, soil and climatic requirement.
24. Berseem and Desmodium -varieties, cultural practices and yield.
25. Silage and hay making – green manure and green leaf manure crops.
26. Sesbania sp., Koringi and Glyricidia – economic importance, soil and climatic requirement.
27. Sesbania sp., Koringi and Glyricidia -varieties, cultural practices and yield.
28. Tuber crops- Potato and sweet potato - Origin, geographical distribution, economic importance, soil and climatic requirements, varieties and cultural practices.
29. Tapioca and turmeric - Origin, geographical distribution, economic importance, soil and climatic requirements, varieties and cultural practices.
30. Narcotics - Tobacco - Origin, geographical distribution, economic importance, soil and climatic requirements.
31. Tobacco varieties and cultural practices.
32. Tobacco yield and curing methods.
33. Betel vine - Origin, geographical distribution, economic importance, soil and climatic requirements.
34. Betel vine - varieties, cultural practices and yield.

### **PRACTICAL SCHEDULE**

1. Identification of sugar crops, fibre, forage, green manure and narcotics in the crop cafeteria.
2. Nursery preparation and management for Sugarcane.
3. Nursery preparation and management for Tobacco.
4. Acquiring skill in field preparation, sowing and manuring of crops under pure and intercropping situations.
5. Acquiring skill in different seed treatment techniques and foliar nutrition of crops.
6. Estimation of plant population per unit area of sugar, fibres, narcotics and tuber crops.
7. Acquiring skill in after - cultivation practices in sugarcane – detrashing, Cotton - earthing up, Tobacco - topping.
8. Study on growth parameters of sugar, fibre, forage crops, Green manures and narcotics.
9. Study on yield parameters and estimation of yield in sugar, fibre and forage crops.
10. Study on yield parameters and estimation of yield in medicinal and aromatic crops, tuber crops and narcotics.
11. Visit to Sugarcane Research Station to study cultivation of sugarcane and its by products.
12. Visit to betelvine field and acquiring skill on cultivation practices.
13. Observation on harvest symptoms of sugar crops.
14. Observation on harvest symptoms of fibre crops, narcotics and tuber crops.
15. Working out input requirements and cost of cultivation for important sugar crops.
16. Working out input requirements and cost of cultivation for important fibre crops, narcotics and tuber crops.
17. **Practical Examination**

### **REFERENCES**

1. Chidha Singh. 2010. Modern techniques of raising field crops. Oxford and IBH Publishing Co. Pvt. Ltd, New Delhi.
2. Crop Production Guide. 2005. Directorate of Agriculture, Chennai and Tamil Nadu Agricultural University, Coimbatore.
3. Singh. S.S. 2002. Crop management under irrigated and rainfed conditions. Kalyani Publishers, New Delhi.
4. Tomar,G.S., Tomar,S.P.S. and Khanjanji, S.N. 2011. Science of Crop Production Part II, Kushal Publications and Distributors, Varanasi (U.P.).



## PAT 223 APPLIED PLANT PATHOLOGY (2+1)

### OBJECTIVES

The subject covers the basic aspects of plant disease management through physical, chemical and biological methods devising for effective management techniques to reduce the losses.

### THEORY

#### Unit I: Principles of Plant Disease Management

History of Disease management – Definition for Plant Diseases – Causes of Plant Diseases – Classification of Plant Diseases-Principles of Plant Diseases Management – Prophylaxis & Immunization – Prophylaxis: Avoidance, Exclusion, Eradication and direct Protection

#### Unit II: Epidemiology and Resistance

Epidemiology of Plant Diseases – Survival and Dispersal of plant pathogens- Disease surveillance, assessment and forecasting - Immunization - cross protection and host plant resistance – Types of resistance - vertical and horizontal resistance.

#### Unit III: Biological and chemical control

Biological Control - Biotechnological approach for crop disease management - Fungicides – characteristics of an ideal fungicide – classification – group of fungicides – antibiotics – Formulations – methods of application of fungicides and compatibility with other agrochemicals – Phytotoxicity of fungicides – precautions and safety measures in handling of fungicides.

#### Unit IV: Nematology

History of economically important plant nematodes up to genera level with the help of keys and description. Symptoms caused by nematodes with examples. Study of White tip of paddy, ear cockle of wheat, root knot of tomato and brinjal. Interaction between plant parasitic nematodes and disease causing fungi, bacteria and viruses.

#### Unit V: Management of nematodes

Cultural methods (crop rotation, fallowing, soil amendments, other land management techniques), physical methods (soil solarisation, hot-water treatment) Biological methods, Chemical methods (fumigants, non fumigants) of nematode management. Resistant varieties.

### PRACTICAL

Classification and grouping of fungicides. Preparation of Bordeaux Mixture (1%) and Bordeaux Paste (10%) and delivery system.- Mass multiplication of biocontrol agents -methods of application. Preparation of leaf extracts, oil emulsion of neem and antiviral principles.-Survey and Assessment of important plant diseases. Methods of nematode survey – sampling methods, collection of soil and plant samples; Extraction of nematodes from soil and plant tissues following combined Cobb's decanting-sieving and Baermann funnel technique, counting and estimation of plant parasitic nematodes; Preparation of temporary and permanent mounts; Experimental techniques used in pathogenicity studies with root knot nematode.

### THEORY SCHEDULE

1. History and definition for plant disease management – Causes of plant diseases –Classification of plant diseases.
2. Principles of Plant Disease Management – prophylaxis and immunization- prophylaxis: avoidance, exclusion, eradication and direct protection
3. Exclusion : Plant quarantine – domestic, international and embargo – exotic diseases, phyto- sanitary certificate.
4. Eradication and various methods of eradications including cultural methods
5. Epidemiology of plant diseases
6. Survival and spread of plant pathogens- Disease surveillance – assessment and forecasting.
7. Biological control – definition - mechanism of action
8. Mass production of *Trichoderma viride*, methods of application
9. Biological control – *Pseudomonas fluorescens* & *Bacillus subtilis* - methods of application - Plant products – antiviral principles – preparation – methods of application
10. Biotechnological approaches in plant diseases management
11. Meristem tip culture, somoclonal variation, coat protein mediated resistance and genetic engineering.
12. Diseases management through host plant resistance – cross protection.
13. Types of resistance – Vertical and horizontal resistance
14. Direct protection – chemical - Chemicals : Fungicides – Definition – classification of fungicides based on mode of action, general uses and chemical nature
15. Copper, sulphur and mercury fungicides - classification, and uses
16. Quinone, Heterocyclic nitrogen compounds,Organo tin compounds, Benzene compounds fungicides - classification, and uses
17. Mid semester examinations

18. Systemic fungicides etc.- classification, and uses.
19. Fungicide formulations
20. Antibiotics- classification, and uses.
21. Methods of application: seed, soil, foliar and post harvest treatments Special methods: swabbing, Pseudostem injection etc.,
22. Phytotoxicity and Compatibility of fungicides
23. Precautions and safety measures in handling of fungicides.
24. History of phytonematology - Economic importance
25. General characteristics of plant pathogenic nematodes - Nematode general morphology and biology.
26. Identification of economically important plant nematodes up to generic level with the help of keys and description
27. Symptoms caused by nematodes with examples.
28. Study of white tip of paddy, ear cockle of wheat, root knot of tomato & brinjal
29. Interaction between plant parasitic nematodes and disease causing fungi, bacteria and viruses.
30. Different methods of nematode management
31. Cultural methods (crop rotation, fallowing, soil amendments, other land management techniques)
32. Physical methods (soil solarisation, hot water treatment)
33. Biological methods
34. Chemical methods (fumigants, non fumigants) -Resistant varieties

### **PRACTICAL SCHEDULE**

1. Mass multiplication of *Trichoderma viride* and methods of application
2. Mass multiplication of *Pseudomons fluorescens*, *Bacillus subtilis* and methods of application
3. Preparation of leaf extracts, oil emulsion of neem and antiviral principles.
4. Survey and assessment of important plant diseases
5. Meristem tip culture and AVP Preparation
6. Classification and grouping of fungicides.
7. Preparation of Bordeaux mixture (1%) , Bordeaux paste (10%), and delivery system and calculation of recommended dose of fungicides.
8. Methods of application of fungicides as seed treatment.
9. Methods of application of fungicides to soil and foliar applications.
10. Field visit
11. Demonstration and production of immunized seedlings in citrus.
12. Methods of survey – sampling methods, collection of soil and plant samples
13. Extraction of nematodes from soil and plant tissues following combined Cobb's decanting–sieving and Baermann funnel technique
14. Counting and estimation of plant parasitic nematodes; Preparation of temporary and permanent mounts
15. Experimental techniques used in pathogenicity studies with root knot nematode.
16. Preparation of temporary and permanent mounts
17. Final practical examinations

### **REFERENCES**

1. Nene, Y.L. and Thapliyal, P.N. 1998. Fungicides in Plant Disease Control. Oxford and IBH publishing Co. Ltd., New Delhi.
2. Prakasam, V., T.Raguchander and K.Prabakar, 2006. Applied Plant Pathology, A.E. publications, Coimbatore
3. R.K. Walia and H.K. Bajaj. 2009. Text book on Introductory Plant Nematology, ICAR, New Delhi.
4. Chattopadhyay, S.G. 1998. Principles and Procedure of Plant Protection, Oxford and IBH publishing co. Ltd., New Delhi.
5. P.D. Sharma. 2004. Plant Pathology. Rastogi Publications, Meerut, India.

## **GPB 224 BREEDING OF FIELD AND HORTICULTURAL CROPS (2+1)**

### **OBJECTIVES**

- To impart knowledge about specific breeding techniques followed in crop improvement of various Field crops and Horticultural crops.

### **THEORY**

Centres of origin – putative parents – related wild species – classification – chromosome number – objectives of breeding – quantity, quality, stress breeding – methods of breeding – conventional and innovative – distance hybridization – heterosis breeding and latest varieties of the following crops.

**Unit I: Breeding of Grain Crops**

Rice, Wheat, Grain and fodder Maize, Grain and fodder Sorghum, Pearl millet, Finger millet, Foxtail millet, Kodo millet, Little millet, Proso millet and Barn yard millet.

**Unit II: Breeding of pulses**

Redgram, Bengal gram, Green gram, Black gram, Grain and fodder Cowpea, Soybean, Horse gram and Lablab

**Unit III : Breeding of oilseeds and Fibres**

Groundnut, Gingelly, Mustard, Castor, Sunflower, Safflower, Niger, Coconut and Oilpalm; Cotton, Jute and Mesta

**Unit IV; Breeding of sugar crops, Fumitories, Masticatories and Fodder crops**

Sugars : Sugarcane, Sugar beet; Potato, Tapioca, Tobacco, Betelvine; Guinea grass, Napier, Pearl millet – Napier, *Cenchrus sp.*, Paragrass, Lucerne, Stylosanthus, Desmanthus, Desmodium, Siratro and Subabul;

**Unit V: Breeding of Horticultural crops**

Bhendi, Brinjal, Tomato, Chillies, Cucumber Guava, Banana, Citrus, Papaya, Mango, Chrysanthemum, Jasmine, Rose and Marigold,

**PRACTICAL**

Observation of plant morphology and floral biology – Anthesis and Pollination – selfing and crossing techniques – distant hybridization – study of wild species in the above crops.

**THEORY SCHEDULE**

Centres of origin – putative parents – related wild species – classification – objectives of breeding – methods of breeding – quantity – Quality – stress – conventional – innovative – heterosis breeding – distant hybridization and important varieties in following crops:

1. Rice.
2. Rice.
3. Rice.
4. Wheat, Grain and fodder Maize
5. Grain and fodder Sorghum,
6. Pearl millet.
7. Finger millet, Foxtail millet, Kodo millet,
8. Little millet, Proso millet and Barn yard millet.
9. Redgram ,
10. Bengal gram
11. Greengram,
12. Blackgram, Grain and fodder Cowpea
13. Soybean, Horsegram, lab-lab
14. Groundnut
15. Gingelly and Mustard
16. Castor and Sunflower
17. Safflower , Niger
18. Mid-Semester examination
19. Coconut
20. Oilpalm
21. Cotton
22. Jute, Mesta,
23. Sugarcane,
24. Potato, Tapioca
25. Tobacco, Betelvine
26. Guinea grass, Napier,
27. Pearl millet – Napier, *Cenchrus sp.*, Paragrass.
28. Lucerne, Stylosanthus, Desmanthus, Desmodium, Siratro, Subabul
29. Bhendi, Brinjal,
30. Tomato,
31. Chillies, Cucumber
32. Breeding for fruit crops-Guava, Banana, citrus
33. Breeding for fruit crops-Papaya, Mango
34. Breeding for flower crops - Chrysanthemum
35. Jasmine, Rose, Marigold

## PRACTICAL SCHEDULE

Observation on floral biology – anthesis and pollination – selfing – crossing techniques – observation on wild species – maintenance of crossing ledger – pedigree record – in following crops.

1. Rice.
2. Wheat and Maize.
3. Sorghum and Pearl millet. Finger millet, Little millet, Kodo millet, Barn yard millet, Proso millet and Foxtail millet.
4. Redgram and Bengal gram.
5. Green gram, Black gram and Cowpea; Soybean, Horse gram and Lab-lab.
6. Groundnut, Sesame and Sunflower.
7. Safflower, Niger, Mustard. Castor, Coconut and Oilpalm
8. Cotton, Jute and Mesta.
9. Sugarcane, sugar beet, potato, tapioca, tobacco and betel vine.
10. Guinea grass, fodder Sorghum, fodder maize fodder pearl millet, Pearl millet – Napier hybrids, *Cenchrus*.
11. Lucerne, fodder cowpea, *Desmanthus*, desmodium, stylo, siratro, subabul ; Green manures – daincha, sunnhemp.
12. Chillies, bhendi, brinjal
13. Tomato, cucumber
14. Guava, banana, citrus
15. Papaya, mango,
16. Chrysanthemum, jasmine, rose, marigold
17. Final Practical Examination

## REFERENCES

1. Chopra, V.L. 1994. Plant Breeding. Theory and Practice. Oxford and IBH Publishing Co., New Delhi.
2. Singh, B.D. 2007. Plant breeding - Principles and methods. Kalyani Publishers, New Delhi.
3. Phoelman, J.N. and Borthakur, 1969. Breeding Asian field crops, Oxford & IBH Publishing Co., New Delhi.
4. Briggs, F.N. and P.F. Knowels, 1970. Introduction to plant breeding. Reinhold, New York.
5. Harihar Ram and Hari Govind Singh, 1994. Crop breeding and Genetics. Kalyani Publishers, New Delhi.

## HOR 225 PRODUCTION TECHNOLOGY OF VEGETABLE AND FLOWER CROPS (2+1)

### OBJECTIVE

The students will be educated on the cultivation aspects of major vegetable and flower crops

### THEORY

#### Unit I: Importance of vegetables, production & post harvest practices

Importance of vegetable growing –area and production of vegetables in India and Tamil Nadu- Nutritive value of vegetables –classification of vegetables –types of vegetable growing –vegetable forcing – precession farming in vegetable cultivation. Importance of post harvest technology in vegetables -Pre cooling, grading, packing, packaging materials - Pre storage treatments- methods of storage - low temperature storage, CAS, hypobaric storage, irradiation and low cost storage structures – value addition.

#### Unit II: Production techniques of important tropical vegetable crops

Climate and soil – varieties and hybrids – seeds and sowing – nutrient management – irrigation and fertigation management – weed management – cropping systems in vegetable crops - vegetable production under protected structures – maturity indices – harvest of following vegetable crops: Tomato, chilli, brinjal, bhendi, onion, gourds, and dolichos bean, cassava, sweet potato, Elephant foot yam, radish, amaranthus and moringa

#### Unit III: Production techniques of important temperate vegetable crops

Climate and soil – varieties and hybrids – seeds and sowing – nutrient management – irrigation and fertigation management – weed management – cropping systems in vegetable crops - vegetable production under protected structures – maturity indices – harvest of following vegetable crops: Peas, French beans, carrot, beetroot, cabbage, cauliflower, capsicum, knol-khol, potato.

#### Unit IV: Importance and production technology of commercial loose flowers

Importance, scope, constraints and future prospects – area and production – floriculture industry - export potential– cultivation of Loose flowers - Soil and climate – varieties – propagation – nursery practices – planting methods – pinching, training and pruning - nutrient and water management – role of growth regulators – harvest– post-harvest management – grading and packaging of rose, jasmine, chrysanthemum, tuberose, crossandra and marigold.

## Unit V : Production technology of cut flowers

Cut flowers – Protected cultivation of cut flowers - soil and climate - varieties –propagation – nursery practices – planting methods – special practices – nutrient, water and weed management – fertigation – role of growth regulators – harvest - post harvest management – grading and packaging – export standards of cut rose, gladiolus, carnation, cut chrysanthemum, gerbera, anthurium and tropical orchids.

### PRACTICAL

Preparation of nursery beds, seed treatment and sowing – preparation of main field and sowing / transplanting – laying out of nutrition garden - manures and manuring – irrigation methods - practices in use of plant growth regulators - identification of physiological disorders - identification of varieties and hybrids - visit to green house/polyhouse units. Identification of varieties – propagation - seed treatment – sowing - planting - training and pruning – shade management - fixing maturity standards – harvesting - visit to Floriculture industries/ floral oil extraction units and flower markets. Study of post harvest handling and processing of vegetables and Flowers.

### THEORY SCHEDULE

1. Importance of vegetable growing in India and Tamil Nadu and classification of vegetables.
2. Types of vegetable growing and cropping systems.
3. Precession farming in vegetable cultivation.
4. Post harvest technology and value addition in vegetables.
5. Climate and soil –varieties and hybrids –seeds and sowing – nutrient management –irrigation and fertigation management – weed management – maturity indices – harvesting and post harvest management of following tropical vegetable crops: Tomato and Brinjal.
6. Chillies
7. Bhendi and Onion.
8. Pumpkin, Ash gourd and Bottle gourd.
9. Snake gourd, Ribbed gourd and Bitter gourd.
10. Dolichos bean and cassava
11. Sweet Potato, Elephant foot yam and Radish
12. Amaranthus and Moringa.
13. Climate and soil –varieties and hybrids –seeds and sowing – nutrient management –irrigation and fertigation management – weed management – maturity indices – harvesting and post harvest management of following temperate vegetable crops: Peas and French beans.
14. Carrot and beetroot
15. Cabbage, Cauliflower and Knolkhol.
16. Potato
17. Protected cultivation of tomato, capsicum and cucumber
- 18. Mid Semester Examination**
19. Value addition of important vegetables (Tomato, Chilli, Onion, Peas, Potato and Cassava).
20. Importance, scope and future prospects - area and production and commercial floriculture industry
21. Export potential of commercial flowers.
22. Protected cultivation – Importance and constraints in flower production
23. Soil and climate – Varieties- planting-pruning methods-special horticultural practices - nutritional management - role of growth regulators-harvesting– post harvest management – grading and packing of following flower crops: Rose
24. Jasmine
25. Chrysanthemum
26. Tuberose
27. Crossandra
28. Marigold
29. Protected cultivation structure- growing media and climatic requirements – Varieties- planting-pruning methods-special horticultural practices - nutritional management - role of growth regulators-harvesting– post harvest management – grading and packing of following flower crops: Cut rose
30. Gladiolus
31. Carnation
32. Cut Chrysanthemum
33. Gerbera
34. Anthurium and Tropical orchids

### PRACTICAL SCHEDULE

1. Nursery management and layout of kitchen garden.
2. Practices in manuring, fertilizer application and irrigation in vegetables.

3. Practices in use of plant growth regulators in vegetable crops.
4. Identification of physiological disorders in major vegetable crops.
5. Identification and description of varieties and hybrids in major vegetable crops.
6. Study of maturity standards and harvesting of vegetables.
7. Visit to greenhouse/ polyhouse units.
8. Visit to vegetable processing unit
9. Identification and description of varieties in rose and jasmine
10. Identification and description of varieties in chrysanthemum.
11. Identification and description of varieties of crossandra and marigold
12. Identification and description of varieties of tuberose
13. Identification and description of varieties of cut rose, anthurium, carnation and gerbera.
14. Media preparation and potting of cut flowers
15. Visit to floriculture industries
16. Visit to floral concrete and oil extraction units
- 17. Practical Examination**

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1. Gopalakrishnan, T.R. 2007. Vegetable Crops. Horticultural Science Series (Series Editor K.V.Peter). New India Publishing Agency.
2. Peter.K.V. 2000. Genetics and Breeding of Vegetables, ICAR, Publication.
3. Mini, C. and Krishnakumar, K. 2004. Leaf Vegetables. Agro tech Publishing Academy, Udaipur
4. Thamburaj, S. and Narendra Singh .2001. Vegetables, Tuber crops and Spices, Directorate of information and publications of agriculture, ICAR,New Delhi.
5. Bhattacharjee, S.K and De L.C (2003) Advanced Commercial Floriculture Vol. (1) Aavishkar publishers, Distributors, Jaipur.
6. Bhattacharjee, S.K and De L.C (2005) Medicinal Herbs & Flowers, Aarishkar, Jaipur.
7. Bose, T.K., Yadav, L.P., Pal. P., Parthasarathy, V.A., Das. P., 2003. Commercial flowers. Vol. I and II. Naya udyog, Kolkata-6.

## **AEC 226: AGRICULTURAL MARKETING, TRADE AND PRICES (1+1)**

### OBJECTIVES

The objective of this course is to provide knowledge to the students on the theory and practice of Agricultural Marketing and exports and imports with special reference to Indian scenario.

### THEORY

#### **Unit I Agricultural Marketing – Nature and Scope**

Market and Marketing: Definitions, components and dimensions of a market. Agricultural Marketing: Concepts and definitions, scope and subject matter. Classification of markets. Role of market functionaries - market forces and price determination. Marketing of agricultural Vs manufactured goods. Producer surplus of agricultural commodities: Definition, producer surplus. Marketable and Marketed surplus: Definition, importance and factors affecting marketable surplus.

#### **Unit II Marketing Functions and SCP Paradigm**

Marketing functions: Buying and selling- packaging and transportation - grading and standardization - storage and warehousing – processing and value addition. Market structure – conduct - performance paradigm (SCP) – market structure meaning, components, dynamics of conduct and performance.

#### **Unit III Marketing Efficiency and Marketing Institutions**

Marketing channels: Definition and channels for different products. Market integration: definition and types. Marketing efficiency: Meaning and definition. Marketing costs, margins and price spread. Factors affecting marketing costs. Reasons for higher marketing costs. Ways of reducing marketing costs. Concepts of supply chain management and value enhancement. Marketing of agricultural inputs. Role and objectives of marketing institutions: State and central – objectives - cooperatives, commodity groups, state trading, ware housing, FCI, PDS, - quality control, AGMARK.

#### **Unit IV Trade in Agricultural Products**

Theories of Trade: Absolute and comparative advantage - status of agricultural exports / imports in India and their share. Barriers to trade – tariff and non tariff measures. Role of institutions like UNCTAD and WTO in promoting trade in agricultural products. Free Trade Agreements - implications of AoA - market access, domestic support and export subsidies. New EXIM policy of India – advantages of AEZs.. Export promotion organization: APEDA, MPEDA, NHB, commodity boards .

#### **Unit V Agricultural Prices and Risk Analysis**

Price characteristics of agricultural products. Objectives of price policy – role of CACP – Concept of

MSP, FRP (SMP) & SAP. Risk in marketing - Meaning and importance - types of risk - speculation and hedging - futures trading – role of Contract farming in risk mitigation.

## **PRACTICAL**

Farm Survey - preparation of survey schedules - farmers' marketing practices - regulated market and its role in marketing of farm produce - cooperative marketing society – farmers' market - estimation of marketed and marketable surplus - identification of marketing channels - price spread estimation for agricultural / horticultural / livestock products - role of Food Corporation of India (FCI)/Civil Supplies Corporation in marketing of agricultural produce - Central Warehousing Corporation (CWC) / State Warehousing Corporation (SWC) and their role in storage of farm produce – Functions of NAFED and TANFED - Agmark Laboratory/Grading institutions - Commodity Boards - export oriented units - analyzing the implications of trade liberalization -time series analysis of prices - trend and seasonal variations, cyclical and irregular variations - index numbers.

## **THEORY SCHEDULE**

1. Market -definitions-components-dimensions. Agricultural Marketing- definition – scope and subject matter. Classification of market and approaches to the study of marketing - functional, institutional, commodity, behavioral system.
  2. Market functionaries and market forces. Marketing of agricultural Vs manufactured goods. Characteristics of agricultural and horticultural commodities in relation to marketing.
  3. Producer surplus of agricultural commodities: Definition and types of producer surplus. Marketable and marketed surplus- importance and relationship - factors affecting marketable surplus.
  4. Marketing functions- buying and selling- packaging and transportation –grading and standardization--storage and warehousing -- processing and value addition
  5. Market SCP paradigm. Market Structure, Conduct & Performance - definitions- components and their dynamics
  6. Marketing channel -definition-channels for different products. Marketing costs, margins and price spread - concepts- importance-factors affecting cost of marketing. Reasons for higher marketing costs. Ways of reducing marketing costs.
  7. Marketing efficiency-operational and pricing. Market integration-vertical, horizontal and conglomeration.
  8. Factor market--marketing of various agricultural inputs-channel of distribution - input market promotional activities by firm.
- 9. Mid Semester Examination**
10. Role of Government in promoting agricultural marketing viz., regulated markets, cooperative markets and farmers markets. Advantages of modern marketing system over traditional agricultural marketing system .
  11. Directorate of Marketing and Inspection – AGMARK - grading and quality control. NAFED and TANFED, State Agricultural Marketing Boards, and FCI. Activities of National Horticultural Board, NDDB and Commodity Boards.
  12. Legal measures for improving agricultural marketing- APMC Act. Supply chain management for agricultural commodities and value enhancement.
  13. Absolute and comparative advantage trade theories – Concepts of domestic trade, free trade and international trade. Share of agricultural commodities in total trade. Major exports and imports of agricultural and agri-allied commodities.
  14. Institutions for promoting trade in agricultural commodities – national and international- GATT, UNCTAD and WTO. Agreement on Agriculture – market access, domestic support and export subsidy.
  15. New EXIM policy of India - Role of agri. export zones – export promotion Councils – APEDA, MPEDA and ITPO.
  16. Agricultural Prices - function and scope - price characteristics of agricultural products. Food policy and prices -Procurement of food grains- buffer stock. Role of administered prices – MSP, SMP & SAP.
  17. Risk in marketing - types of risk- speculation and hedging. Price risk – futures trading. Forward Vs Futures market. Role of contract farming in risk management.

## **PRACTICAL SCHEDULE**

1. Farm Survey-Preparation of survey schedules for collection of data.
2. Farm visit to collect information on marketing practices of agricultural commodities and marketing problems.
3. Visit to weekly shandy/vegetable market/ farmers market.
4. Regulated market and its role in marketing of farm produce – field visit.

5. A visit to cooperative marketing society to study the services and marketing of farm produce.
6. Visit to wholesale market/ commission mundy.
7. Estimation of marketable and marketed surplus
8. Price spread estimation for major agricultural and agri-allied products
9. Estimation of marketing efficiency and market integration
10. Visit to FCI/ CSC
11. CWC/ SWC and their role in storage of farm produce.
12. Agmark laboratory/grading institutions-visit.
13. Marketing of farm inputs - visit to farm input dealer
14. Visit to commodity boards/ AEZ/Export oriented Units.
15. Time series analysis of prices - TCSI variations.
16. Index number-construction and uses.
17. **Final Practical Examination.**

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## AEX 227 EXTENSION METHODOLOGIES AND TRANSFER OF AGRICULTURAL TECHNOLOGY (1+1)

### OBJECTIVES

- To learn about communication process, models and elements
- To learn about the use of various communication methods
- To learn about modern information technologies

### THEORY

#### Unit I: COMMUNICATION

Communication – meaning – definition – models – elements and their characteristics – types and barriers in communication.

#### Unit –II: PROGRAMME PLANNING AND TRAINING

Programme planning – meaning, definition, principles, steps in programme development process, monitoring and evaluation of extension programmes. Types of training, training to farmers, farm women and rural youth, FTC & KVK.

#### Unit III: EXTENSION TEACHING METHODS

Extension teaching methods - Audio-Visual aids – definition – classification – purpose, planning and selection, combination and use – individual, group and mass contact methods – merits and demerits.

#### Unit IV: MODERN COMMUNICATION GADGETS

Modern communication sources – internet, video and teleconferencing, Interactive Multimedia Compact Disk (IMCD), village kiosks, Kissan Call Centre (KCC), mobile phone

#### Unit V: DIFFUSION AND ADOPTION

Diffusion – meaning and elements. Adoption – meaning –adopter categories and factors influencing adoption, stages of adoption, Innovation decision process and attributes of innovation consequences of adoption.

### PRACTICAL

Communication pattern in State Department of Agriculture, KVK – ongoing agricultural and rural development, ATMA and SHGs – preparation of visual aids – extension literature – news stories, feature stories – interview articles – photo journalism – writing script for radio and television – spread and acceptance of farm technologies at village level.

### THEORY SCHEDULE

1. Communication-meaning, definition, functions, elements and their characteristics.
2. Types and barriers of communication and models of communication.
3. Programme planning-definition, scope, principles, importance, steps, evaluation, keys for evaluation.
4. Training-types, institutions training for farmers, farm women and rural youths and importance
5. Extension teaching methods-definition, meaning, functions, selection and classification.



6. Individual contact methods-farm and home visit, office call, telephone call and personal letter-observation and result demonstration.
7. Group contact methods-method demonstration, meeting, lecture, debate, workshop, seminar, forum and conference
8. Group contact methods-symposium, panel, brainstorming, buzz session, role playing and simulation games.
- 9. Mid Semester Examination.**
10. Mass contact methods-campaign, exhibition, farmers day and field trips - purpose, procedures, advantages and limitations.
11. Mass contact methods-written communication-circular letter, leaflet, folder, pamphlet-purpose, procedures, advantages and limitations.
12. Audio visual aids-definition, scope and importance, classification-merits and demerits-factors influencing planning and selection.
13. Modern communication gadgets-computer networks, internet, video and teleconferencing.
14. Modern communication sources (e-extension)-multimedia devices-mobile phone, Kisan Call Centre, Village Knowledge Centre/information kiosks, portal, websites.
15. Diffusion-meaning, definition, elements. Innovation-adoption, meaning, definition.
16. Attributes of innovation and stages of adoption
17. Innovation-decision process, functions, adopter categories-factors influencing adoption-impact and constraints in technology transfer programmes.

### **PRACTICAL SCHEDULE**

1. Understanding the communication pattern in State Department of Agriculture/Horticulture.
2. Study on communication pattern in KVK.
3. Study of ongoing agricultural development programmes.
4. Preparation and practicing of posters, charts, graphs.
5. Preparation and practicing of circular letter, folders and leaflets.
6. Visit to the Department of Agricultural Engineering to study the transfer of technology efforts in farm mechanization.
7. Visit to village and fixing the priorities and selecting a most important problem for preparation of a project.
8. Visit to ATMA implemented village.
9. Studying the role of print media communication in publishing the activities of agriculture and allied fields.
10. Practicing skill on photo journalism
11. Internet, E-Mail communication Practices
12. Visit to All India Radio, to study it's role in agricultural development.
13. Script writing for Radio and Television
14. Preparation of interview schedule to study the spread and acceptance of farm technologies at village level.
15. Data collection
16. Tabulation
17. Presentation of reports.

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## AEG 228: SOIL AND WATER CONSERVATION ENGINEERING (1+1)

### OBJECTIVES

To expose the students in the area of surveying, principles and practices of Chaining compass surveying, plain table and levelling, concept of dynamic process of a watershed resulting in soil erosion, understand the appropriate conservation measures to be adopted for remediation of watershed, various hydraulic Engineering problems like open channel flow, closed conduit, turbines and pumps, principles of ground water, characteristics of aquifers, construction of wells.

### THEORY

#### Unit I: Surveying

Surveying and Levelling – Chain, Compass and Plane Table survey – levelling – Land measurement and computation of area – Simpson’s rule and Trapezoidal rule.

#### Unit II: Soil erosion

Soil Erosion – causes and evil effects of soil erosion – geologic and accelerated erosion - water erosion - causes - erosivity and erodibility - mechanics of water erosion - splash, sheet, rill and gully erosion - Ravines - Land slides – Wind erosion - factors influencing wind erosion - mechanics of wind erosion – suspension, saltation, surface creep

#### Unit III: Soil conservation

Erosion control measures for Agricultural lands – biological measures – contour cultivation – strip cropping – cropping systems – vegetative barriers - windbreaks and shelterbelts - Shifting cultivation - mechanical measures – contour bund – graded bund – broad beds and furrows – basin listing – random tie ridging – Mechanical measures for hill slopes – contour trench – bench terrace – contour stone wall – gully control structures – permanent and temporary structures. Farm ponds – percolation ponds- Watershed Management.

#### Unit IV: Irrigation and drainage

Irrigation - Measurement of flow in open channels - velocity area method - Rectangular weir - Cippoletti weir - V notch - Orifices - Parshall flume - Duty of water - Irrigation efficiencies - Conveyance of irrigation water - canal lining - Underground pipe line system - Surface irrigation methods - Borders, furrows and check basins - Drip and sprinkler irrigation– Agricultural drainage - Surface drainage systems – Sub-Surface drainage systems - Drainage coefficient-design of open ditches.

#### Unit V: Wells and Pumps

Groundwater occurrence – aquifers – types of wells – pump types – reciprocating pumps – centrifugal pumps – turbine pumps – submersible pumps – jet pumps – airlift pumps – selection of pumps – operation and their maintenance.

### PRACTICAL

Study of survey instruments - Chains and cross staff surveying - linear measurement - plotting and finding areas. Compass survey - observation of bearings - computation of angles- Radiation, intersection. Leveling – fly levels – determination of difference in elevation. Contouring – area and volume computation. Design of contour bund and graded bund. Visit to erosion affected areas. Problems on water measurement. Problems on duty of water, irrigation efficiencies. Problems on water requirement - Layout of Sprinkler and Drip systems. Agricultural drainage. Study of different types of wells and its selection. Study of reciprocating pump, centrifugal pump, submersible pumps & jet pumps- Selection of pumps.

### THEORY SCHEDULE

1. Introduction - Land surveying - Uses in agriculture.
2. Chain cross staff and compass surveying - Computation of angles.
3. Radiation, intersection and traversing.
4. Dumpy level - setting, observation and tabulation of readings - computation of land slope - difference in elevation.
5. Computation of area and volume – Simpson’s rule and Trapezoidal rule.
6. Soil Erosion – causes and evil effects of soil erosion – geologic and accelerated erosion
7. Water erosion - causes - erosivity and erodibility - mechanics of water erosion
8. Splash, sheet, rill and gully erosion - Ravines - Land slides
9. Wind erosion - factors influencing wind erosion - mechanics of wind erosion – suspension, saltation, surface creep
10. Effects of water and wind erosion
11. Erosion control measures for Agricultural lands – biological measures – contour cultivation – strip cropping
12. Cropping systems – vegetative barriers - windbreaks and shelterbelts - Shifting cultivation

13. Mechanical measures – contour bund – graded bund
14. Broad beds and furrows – basin listing – random tie ridging
15. Mechanical measures for hill slopes – contour trench – bench terrace – contour stone wall
16. Gully control structures – permanent and temporary structures.
17. Farm ponds – percolation ponds.
18. Irrigation - Measurement of flow in open channels - velocity area method
19. Rectangular weir - Cippoletti weir - V notch
20. Orifices - Parshall flume
21. Duty of water - Irrigation efficiencies
22. Conveyance of irrigation water - canal lining
23. Underground pipe line system
24. Surface irrigation methods - Borders, furrows and check basins
25. Components of Drip and sprinkler irrigation system
26. Agricultural drainage – need - Surface drainage systems
27. Surface drainage systems - Drainage coefficient
28. Groundwater occurrence – aquifers types
29. Types of wells
30. Pump types – Reciprocating pumps – Centrifugal pumps
31. Turbine pumps – Submersible pumps
32. Jet pumps – Airlift pumps
33. Selection of pumps – operation and their maintenance.

### **PRACTICAL SCHEDULE**

1. Study of survey instruments - chains - compass - plane table (only demo) - dumpy level.
2. Chains and cross staff surveying - linear measurement - plotting and finding areas.
3. Compass survey - observation of bearings - computation of angles.
4. Compass - Radiation, intersection.
5. Levelling – fly levels – determination of difference in elevation.
6. Contouring – area and volume computation.
7. Design of contour bund and graded bund.
8. Visit to erosion affected areas.
9. Problems on water measurement.
10. Problems on duty of water, irrigation efficiencies.
11. Problems on water requirement - agricultural drainage.
12. Layout of Sprinkler and Drip systems.
13. Study of different types of wells and its selection.
14. Study of reciprocating pump & centrifugal pump
15. Study of submersible pumps & jet pumps
16. Selection of pumps.

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5. Murthy, V.V.N. 2005, Land and water management, Kalyani publishing, New Delhi.
6. Michael, A.M. Irrigations, Theory and Practice, Vikas Publication House Pvt. Ltd., New Delhi.

## STA 229: STATISTICS (1+1)

### OBJECTIVES

1. Statistics plays a major role in all fields of science. When elementary topics like primary data collection, presentation of data, diagrams and graphs etc are taught to the student of agriculture, first they learn the basic concepts of Statistics.
2. By learning sampling methods, test of significance, correlation and regression they come to know practically how to select samples using various methods of sampling and how to test certain hypothesis based on student's 't' Statistic and, Chi-square Statistic. Using Regression analysis, they may be able to predict the future using the past data.
3. By learning basic principles of design of experiments and basic designs they can conduct practically certain Agricultural experiments with their knowledge of Statistics.

### THEORY

#### Unit I: Data collection diagrams and graphs

Different kinds of data, Primary, Secondary, Quantitative and Qualitative data- Presentation of Data - Purpose and Uses – Bar diagrams, Comparative bar diagram, percentage bar diagram, Pie-diagram and Uses, Histogram frequency curve, frequency polygon O<sub>give</sub> curves.

#### Unit II: Measures of Central Tendency and Measures of Dispersion

Mean, Geometric Mean, Median, Mode. Range, Standard deviation, Co-efficient of variation.

#### Unit III: Sampling methods and Tests of Significance

Kinds of Sampling: SRS (WR) and (WOR), Stratified Random Sampling, Systematic Sampling. Meaning and various steps involved in Tests of Significance. Tests based on 't' and  $\chi^2$ -Statistics: 't' test for mean, difference of means-Chi-square test for association of attributes – 2x2 contingency only limitations of Chi-square test.

#### Unit IV: Correlation and Regression

Direct and indirect correlation – scatter diagram -Karl Pearson's Correlation Co-efficient Meaning and uses of simple linear regression equation – prediction using the equations.

#### Unit V: Design of experiments and Basic Designs

Basic Principles – randomization replication and local control. Completely Randomized Design (CRD). Randomized complete Block Design (RBD) and Latin Square Design (LSD) and their analyses.

### PRACTICALS

Bar diagram – Frequency curve-frequency polygon – Mean, Geometric mean, Median, Mode, Standard deviation and Co-efficient of variation – t test for Mean, difference of means – Chi-square test for independence of attributes in 2x2 table- correlation co-efficient – Regression equation – Field visit – Completely randomized design – Randomized block design – Latin square design – Split Plot design – Factorial experiment  $2^2$ ,  $2^3$  factorial design conducted in RBD.

### THEORY LECTURE SCHEDULE

1. Different kinds of data, primary and secondary data, qualitative and quantitative data, presentation of data.
2. Bar diagrams, Component Bar diagram, Percentage Bar diagrams, Pie diagram, Picto grams, Uses.
3. Histogram, Frequency curve, Frequency polygon, O give curves, uses.
4. Mean, Median, Mode.
5. Range, Standard deviation, (raw data), Co-efficient of variation.
6. Standard deviation (grouped data).
7. Types of sampling, SRS (WR) and (WOR), stratified random sampling, Systematic sampling.
8. Test of significance, test based on t, mean and difference of means.
9. Mid semester examination.
10.  $\chi^2$  – test, test for association of attributes 2x2 contingents only, limitations of chi-square test. Correlation, scatter diagram and karl person's Co-efficient of correlation.
11. Regression, Simple linear regression, Prediction using the equation.
12. Design of experiments, Basic principles, randomization, replication and local control.
13. Basic designs.
14. Completely randomized design (CRD).
15. Randomized complete block design (RBD).
16. Latin square design (LSD).
17. Analysis of the above design.

### PRACTICAL SCHEDULE

1. Bar diagram, frequencies curve, frequencies polygon.

2. Mean, Geometric mean, median and mode.
3. Standard deviation and co-efficient of variation.
4. Test based on t-for-mean and difference of mean.
5. Chi-square test for independence of attributes.
6. Correlation Co-efficient.
7. Regression equation.
8. Completely randomized design.
9. Randomized complete block design.
10. Latin square design.
11. Split plot design.
12.  $2^2$  Factorial experiments conducted in RBD.
13.  $2^3$  Factorial experiments conducted in RBD.

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## SEMESTER V

### AEG 310 - RENEWABLE ENERGY (1+1)

#### OBJECTIVES

- This subject will enable the student,
- To gain knowledge on the various renewable energy sources like solar, wind , biogas and biomass.
- To understand the construction and working of various solar energy gadgets, wind mill, bio gas plants and production of bio diesel and ethanol from agricultural produce.

#### THEORY

##### Unit I: Energy scenario

Introduction -energy crisis -energy sources- classification -availability-renewable energy sources- significance- potential and achievements in India.

##### Unit II: Energy conversion techniques and Biogas production

Methods of energy conversion – thermo chemical and biochemical conversion methods-combustion, pyrolysis and gasification - applications- biogas and ethanol production- applications. Biogas technology-Science of production -feed stocks - factors affecting biogas production- types and capacity of biogas plants- KVIC, Janata and Deenbandhu model biogas plants- construction and working principles- comparison features of biogas plants. Applications of biogas – biogas requirements-biogas appliances-environmental considerations – enrichment and uses of biodigested slurry(BDS).

##### Unit III: Thermal Biomass conversion:

Principles of combustion, pyrolysis and gasification – types of gasifiers – producer gas and its utilization. Briquettes – types of briquetting machines – uses of briquettes – shredders.

##### Unit IV: Solar energy and its applications

Solar energy – solar energy applications - solar flat plate and focusing collectors – solar energy gadgets –solar air heaters –solar cookers – solar water heating systems – solar grain dryers –solar photo voltaic systems – solar lantern - solar street lights – solar fencing – solar pumping systems - solar refrigeration system – solar ponds – solar space heating and cooling .

##### Unit V: Wind energy and bio-fuels

Wind energy - types of wind mills – constructional details and applications. Energy from agricultural wastes –liquid Bio fuels -bio diesel and ethanol from agricultural produce – its production & uses.

#### THEORY SCHEDULE

1. Energy crisis-renewable energy sources- significance- potential and achievements in India.
2. Methods of energy conversion – thermo chemical conversion methods-principles of combustion, pyrolysis and gasification and applications-biochemical conversion methods – biogas and ethanol production-principles-applications.
3. Biogas technology-science of production of biogas-feed stocks used - factors affecting biogas

- production- types of biogas plants- capacity determination.
4. Biogas plants - construction and working principles – KVIC, Janata and Deen bandhu model biogas plants- performances.
  5. Applications of biogas – biogas requirements for cooking , lighting and engine operation and electricity production- biogas appliances-environmental considerations - enrichment and uses of biodigested slurry(BDS).
  6. Combustion-improved chulha –single pot chulha – double pot chulha-conventional chulha- biomass gas stove- constructional features, working principles and applications.
  7. Thermo-chemical conversion – principle –chemistry of gasification-gasifiers –types- operation - applications
  8. Briquetting-definition-MED, VED –need for briquetting- benefits of biomass briquettes -elemental composition and physical properties of agro-residues -densification methods.
  9. Briquetting machines – types - principles, features and operation - properties and uses of briquettes.
  10. Solar Energy-characteristics of solar radiation- advantages and disadvantages- types of radiation- solar constant-availability of solar radiation-solar thermal devices – solar water heaters – principle and applications -solar cookers-evacuated tube collector.
  11. Solar driers – natural and forced convection types – working principle –drying of agro-produces in natural as well as forced convection type solar dryers.
  12. Solar PV systems – principle-water pumping applications-solar lantern-principle.
  13. Solar refrigeration- advantages- applications- absorption refrigeration -principle- ammonia-water and Lithium bromide absorption refrigeration systems -solar mechanical refrigeration. Solar pond-principle-types-applications-solar distillation- principle-applications.
  14. Energy available in wind -wind mills -types-water pumping windmills –components- wind power transmission - controls-applications-aerogenerator - components –working principle –types of rotors- wind power transmission - power generation –controls-applications.
  15. Bio-fuels –Importance-use in agricultural sector –demand and growth of bio-fuels- biodiesel production method-flowchart-components-byproducts-utilization- biodiesel pilot plant.. Bio-ethanol -principle of production from cellulosic substances-flowchart – effects of different parameters on ethanol fermentation –types of fermenters-ethanol from sugar substrates-applications in agriculture.

### **PRACTICAL**

1. Study of constructional details of KVIC & JANATHA type and Deen Bandu type bio gas plants,
2. Study of constructional details of different types of Gasifier and Briquette preparation from biomass.
3. Study and find the efficiency of solar cooker
4. Study and find the Performance of a solar still
5. Study and find the Performance of a solar dryer.
6. Study about the working of solar photovoltaic pumping system.
7. Study and performance evaluation of Domestic Solar water heater.
8. Study of Solar Lantern and solar street light
9. Study of different types of wind mills
10. Study the processing of Bio diesel production from Jatropha .

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## **AGR 311 FARMING SYSTEMS AND SUSTAINABLE AGRICULTURE (1+1)**

### **OBJECTIVES**

Learning the concepts of cropping and farming systems as vital tool in enhancing agricultural productivity and intensive farming. Acquiring scientific knowledge and technical knowhow in sustainable agriculture, low input farming and natural resource management.

### **THEORY**

#### **Unit I: Cropping systems- concepts**

Cropping systems - Definition - Principles - Concepts - Classification – mono cropping – intensive cropping - cropping systems of India and Tamil Nadu - Interaction between different cropping systems – Cropping system management – Resource management – land, nutrient, water and weed - Indices for evaluation of cropping systems - Land use - yield advantages - Economic evaluation

#### **Unit II: Farming systems-concepts**

Farming systems - Definition - Principles - Concepts - Enterprises selection and management - interaction between different enterprises with cropping – scope and advantages of Integrated Farming system – evaluation indicators of integrated farming system - Integrated farming system models for different agro eco-systems

#### **Unit III: Sustainable agriculture**

Concept of sustainability and sustainable development-emerging issues- Sustainable agriculture-concept themes- differences between conventional, sustainable, and alternate agriculture- Various alternate agricultural systems-limitations- Modernization of agriculture and its relation to sustainability. Factors affecting ecological balance and ameliorative measures.

#### **Unit IV: LEISA**

Strategies for realizing sustainable agriculture- low vs. high external input agriculture (LEIA vs. HEIA) -Natural resource management as a part of sustainable resource management –crop production practices- animal production practices- Basic ecological principles of LEISA – promising LEISA techniques and practices – improved manure handling – crop residue management.

#### **Unit V: Resource management**

Resource management under constraint situation – Cost reduction strategies in crop production – cropping system, farming system and dry farming – Non-monetary inputs and low cost technologies - Labour management – Resource recycling – Residue management – crop and livestock – Conservation agriculture – principles, concept and scope

#### **PRACTICAL**

Preparation of cropping scheme - working out input requirements for crops, cropping systems - preparation of calendar of operations for wetland, irrigated upland and dry land cropping system - visit to cropping system experiments – working out indices for evaluation of cropping systems – visit to different units: dairy, goat, poultry, fishery. Mushroom, sericulture and biogas - study on evaluation indicators on farming system - preparation of integrated farming system models for different eco-systems - on farm field visit - analysis of farming system models

#### **THEORY - LECTURE SCHEDULE**

1. Cropping system: Definition, Principles and basic concepts- Classification of cropping system - Mono cropping, intensive cropping, multiple cropping, mixed cropping.
2. Major cropping systems prevailing in India and Tamil Nadu for different agro eco-systems - Complementary and competitive interaction in different cropping system – light, nutrient, water and weed.
3. Cropping system management : agronomic requirement for crops and cropping system – selection of crops and varieties, tillage and land shaping, plant population and crop geometry.
4. Cropping system management: water management, soil fertility management and plant protection - Indices for evaluation of cropping system – land use, yield advantage and economics.
5. Farming system: definition, principles and concepts, factors influencing choice and size of enterprises - Scope and advantages of integrated farming system Allied enterprises for wetland, irrigated upland and dryland – selection and management.
6. Interaction between enterprises and cropping – crop + dairy - crop + poultry – crop + fishery - crop + goat - crop + mushroom – crop + sericulture - Resource recycling in integrated farming system.
7. Integrated Farming System evaluation indicators -Integrated farming system - models for wetland, irrigated upland and dryland eco-system- -LEIA & HEIA- concepts and principles.
8. The concept of sustainability and sustainable development-emerging issues- Sustainable agriculture-concept themes-environmental health, economic profitability, and social and economic equity.

#### **Mid-Semester Examination**

1. Conventional, sustainable, and alternate agriculture-Alternate agricultural systems- biodynamic farming, natural farming, organic farming, permaculture, and other farms - limitations.
2. Modernization of agriculture and its relation to sustainability Factors affecting ecological balance and ameliorative measures.
3. Strategies for realizing sustainable agriculture- Natural resource management as a part of sustainable resource management-crop production practices- animal production practices.
4. Low vs. high external input agriculture (LEIA vs. HEIA) - Basic ecological principles of LEISA – promising LEISA techniques and practices.

5. Improved manure handling – crop residue management – strategic use of chemical fertilizers and pesticides.
6. Resource management under constraint situations for irrigated and rainfed farming- Cost reduction strategies in crop production – cropping system, integrated farming system and dry farming.
7. Non-monetary inputs and low cost technologies for crop production - Crop and livestock residue management.
8. Labour management in farming system -Conservation agriculture – principles, concepts and scope.

### **PRACTICAL SCHEDULE**

1. Visit to cropping system experiments in wetland, irrigated upland
2. Preparation of cropping scheme for wetland and working out input requirement
3. Preparation of cropping scheme for irrigated upland and working out input requirement
4. Calendar of operations for wet land and irrigated upland cropping system
5. Working out indices for evaluating the cropping system
6. Visit to dairy, goat, fishery and poultry units
7. Innovative methodologies in rural areas.
8. Organic recycling in various farming situations.
9. Preparation and evaluation of integrated farming system models : wetland eco-system
10. Preparation and evaluation of integrated farming system models : irrigated upland and dryland eco systems
11. On-farm visit to cropping fields and integrated farming system units
12. Low input concepts for sustainable agriculture
13. Resource management in farming systems
14. Inter disciplinary approach in farming system
15. Climatic normal for farming vs livestock.
16. Studies on biofertilizers and raising green manure crops and cover crops

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## **AGR 312: POST HARVEST TECHNOLOGY FOR AGRICULTURAL CROPS (1+1)**

### **OBJECTIVES**

Gaining knowledge on post harvest technology and it's importance. Studying the different post harvest procedures of important field crops.

### **THEORY**

#### **Unit I: Post harvest losses, moisture content and properties**

Post harvest technology –importance-quantitative and qualitative losses – causes and estimates – moisture content – methods of estimation - Physical properties of grains – mass, volume, density, porosity - applications and effect of moisture content on properties.

#### **Unit II: Threshing, cleaning and grading**

Threshing – threshers for different crops – factors affecting threshing- winnowing – manual and power operated winnowers- cleaning, grading and sorting - types of screens - air screen cleaner-reciprocating and rotary types - construction and working principles of spiral separator, magnetic separator, specific gravity separator, colour sorter and inclined belt separator.

#### **Unit III: Shelling, drying and storage**

Shelling equipments - maize sheller, husker sheller, hand and power operated groundnut decorticator - construction and working - performance evaluation - grain drying – principles - advantages - types - batch and continuous, mixing and non mixing – LSU drier – construction and operation - performance of dryers - storage of food grains – factors affecting storage, traditional and improved methods - modified atmosphere storage.

#### **Unit IV: Cereals, pulses and oilseed processing**

Rice processing – traditional and modern rice milling - parboiling, methods, advantages and disadvantages, dehulling, polishing, modern rice mill machineries – wheat milling — roller flour mill - construction and operation - pulse milling - wet, dry and CFTRI methods of pulse milling – equipments



– construction and operation - oilseed processing – methods and machineries used – ghani, rotary and expeller - filter press – construction and operation – solvent extraction process.

#### **Unit V: Value addition and byproducts utilization**

Value addition and by products utilization of cereals- millets – pulses and oilseeds – nutritive value of rice, millets and pulses- fortified food products. .

#### **PRACTICAL**

Determination of moisture content - study of threshers, winnowers and graders – components, operations, adjustment and performance - determination of efficiency of maize shellers, groundnut decorticators, cleaners and graders, rice milling and pulse milling - experiments on tray and thin layer drier- experiments on screw conveyor and bucket elevator, study of improved grain storage structures - exercises on location analysis and preparation of plant layout for food processing industry – visit to food processing industry.

#### **THEORY SCHEDULE**

1. Post harvest losses – causes and estimates – unit operations of crop processing – moisture content – methods of estimation – direct and indirect methods – wet basis and dry basis.
2. Engineering properties of grains – mass, volume, density, bulk density, true density, porosity, surface area and sphericity – applications and effect of moisture content on properties.
3. Threshing – threshers for different crops – factors affecting threshing
4. Winnowing – manual and power operated winnowers- cleaning, grading and sorting.
5. Types of screens - air screen cleaner- reciprocating and rotary types-
6. Construction and working principles of spiral separator, magnetic separator, specific gravity separator, colour sorter and inclined belt separator.
7. Construction and working of maize sheller, husker sheller, hand and power operated groundnut decorticator
8. Grain drying – principles - advantages - types - batch and continuous, mixing and non mixing – LSU drier – construction and operation - performance of dryers.
9. **Mid Semester Examination**
10. Storage of food grains – factors affecting storage, traditional methods - types -bag and bulk storage and silos.
11. Storage of food grains – modified atmosphere storage of grains.
12. Rice processing – traditional and modern rice milling – parboiling – methods of parboiling- advantages and disadvantages of parboiling- dehusking, polishing, modern rice mill machineries.
13. Wheat milling – roller flour mill - important machineries used in wheat milling – construction and operation.
14. Pulse milling - wet, dry and CFTRI methods of pulse milling – equipments – construction and operation.
15. Oilseed processing – methods and machineries used – ghani, rotary and expeller - filter press – construction and operation – solvent extraction process.
16. Storage-different types of storage structures-indigenous and modern storage structure
17. Value addition and byproducts utilization of cereal, millets, pulses and oilseeds.

#### **PRACTICAL SCHEDULE**

1. Determination of physical properties of grain
2. Determination of moisture content by direct and indirect methods
3. Study of types of thresher and components.
4. Performance evaluation of grain winnower.
5. Performance evaluation of grader.
6. Performance evaluation of maize sheller / husk sheller for maize.
7. Performance evaluation of groundnut decorticator.
8. Determination of oil extraction efficiency of power ghani and work out the economics.
9. Quality parameters of paddy.
10. Experiment on shelling of paddy using rubber roll sheller.
11. Visit to traditional rice mill to study the parboiling and milling operation
12. Visit to Modern rice mill to study the parboiling and milling operation
13. Visit to Dhal mill to study the milling of pulses.
14. Assessment of quality of pulses and quality grading.
15. Study of improved grain storage structures
16. Visit to Central warehousing corporation to study the storage and fumigation methods
17. **Final Practical Examination.**

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## **ENT 313 INSECT ECOLOGY, INTEGRATED PEST MANAGEMENT AND INSECTS OF ECOLOGICAL IMPORTANCE (2+1)**

### **OBJECTIVES**

- To study the influence of ecosystems on insect populations.
- To know about various pest management methods.
- To study the importance of pollinators, weed killers, scavengers and other vectors

### **THEORY**

#### **Unit I: Insect Ecology**

Insect Ecology – introduction and definition - anecology, synecology, biome, population, community, niche, ecosystem and agro-ecosystem. Balance of life in nature - trophic level, food chain, food web. Population dynamics - J- shaped growth form, S- Shaped growth form, natality, mortality, dispersal, biotic potential and life table. Environmental resistance on insect population - abiotic factors and biotic factors. Pest – definition, categories, biotypes, losses and causes for outbreaks. Symptoms and nature of damage. Pest surveillance - sampling techniques and forecasting. Concepts of ETL and EIL.

#### **Unit II: Integrated Pest Management and its Components**

IPM - Introduction, definition, importance, Economic Threshold Level, Economic Injury Level, limitations of IPM. Components of IPM – Cultural, Mechanical, Physical and Legal methods – invasive insect pests, Host plant resistance in IPM, Biological methods in IPM - classical biological control, merits and limitations of biological control, Parasitoids, Predators and Pathogens, difference between predator and parasitoid, Types of parasitoids, Types of parasitism, Important families of predators and parasitoids, Microbial control - groups of microbial agents and their actions on insects, Traps in IPM, Push and Pull techniques, Semiochemicals in IPM – Pheromones, Allomones, Kairomones and Synomones and their role in pest management, Insect growth regulators in IPM – Moulting inhibitors and JH mimics, Biotechnology in IPM and Sterile male technique and gamma radiation in IPM.

#### **Unit III: Bio intensive Insect Pest Management**

Mass multiplication and application techniques of important groups of parasitoids, predators, pathogens and entomophilic nematodes. Conservation, importation, augmentation and release of bio control agents. Role of birds in insect and rodent management. Botanical insecticides in IPM – antifeedants and repellants. Formulation techniques of botanicals. Traditional methods in IPM.

#### **Unit IV: Chemical methods of Insect Pest Management and its Ecological Perspectives**

Chemical control – importance and history. Classification of pesticides. Toxicity ranges – LD<sub>50</sub>, LC<sub>50</sub>, etc. Basic and newer formulations of insecticides. Hazards of insecticides - Symptoms of poisoning, first aid and antidotes, Insecticide residues, Insecticide resistance, Insect resurgence, Insecticide contamination and pollution, Bio accumulation and Bio magnification. Compatibility and phytotoxicity. Insecticide resistance and residue management. Newer insecticides in pest management.

#### **Unit V: Integrated Pest Management Strategies and Insects of Ecological Importance**

Integrated pest management strategies in different agro ecosystems – Rice, cotton, sugarcane and coconut. Insects of Ecological Importance - pollinators, weed killers and scavengers and their importance. Role of insects on diseases of human beings - household pests, vectors of human diseases and insects causing annoyance and pests on animals – cattle and poultry.

### **PRACTICAL**

Studies on terrestrial/pond ecosystems. Types and symptoms of insect damage. Sampling techniques for the estimation of insect population and damage. Pest surveillance through light traps, pheromone traps and estimating field incidence. Practices in Cultural, Mechanical and Physical methods. Studies on distinguishing characters of resistance varieties. Traps in pest management. Identification of parasitoids, predators and entomopathogens. Mass culturing techniques of *Trichogramma* and *Chrysopa*. Mass production of NPV and Fungal pathogens. Models of bird perches, owl nesting and placement. Identification of plants of insecticidal value. Preparation of Botanical formulations. Practices in

Traditional methods of pest management. Different groups of pesticide formulations and label information. Precautions in pesticide applications - first aid and antidotes in case of insecticide poisoning. Pesticide application equipments – types and uses. Preparations of spray fluids for field application. Calculation of dose/concentration of insecticides. Compatibility of pesticides and phytotoxicity of insecticides. Effective application of insecticides. Identification of Important species of pollinators, weed killers and scavengers. Identification of Cattle, poultry and household pests. Identification of vectors of human diseases and insects causing annoyance.

**Assignment:** Each student has to submit five numbers of insect damaged plant specimens (Herbarium) and five insecticide labels.

### **THEORY LECTURE SCHEDULE**

1. Definition and importance of Insect ecology. Terminologies related to Insect ecology - anecology, synecology, biosphere, habit, habitat, biome, population, community, niche, ecosystem and agro-ecosystem.
2. Balance of life in nature - Trophic level- producers and consumers, food chain, food web. Population dynamics - J shaped and S Shaped growth form, Natalivity, Mortality-r strategists and K strategists, dispersal, biotic potential and Life table.
3. Effect of abiotic factors on insect population – temperature, moisture, humidity, rainfall, light, atmospheric pressure, air currents etc.
4. Effect of biotic factors on insect population– intra specific, inter specific relations.
5. Definition and categories of pests, biotypes and causes for pest outbreak. Symptoms and losses of pest attack. Sampling techniques, Surveillance and pest forecasting
6. Definition of IPM. Concepts, Scope and limitations of IPM. Concepts of Economic Injury Level (EIL) and Economic Threshold Level (ETL).
7. Definition and examples of Cultural, Physical and Mechanical methods of pest management
8. Host plant resistance – Definition, Types of Resistance-Ecological Resistance - Host evasion - Induced Resistance – Escape. Genetic Resistance - Monogenic-Oligogenic- Polygenic - Major gene - Minor gene. Vertical and Horizontal resistance. Pureline and Multiline resistance. Cross and Multiple resistance. Sympatric and Allopatric resistance.
9. Mechanisms of Host plant resistance – Antixenosis - Antibiosis – Tolerance. Compatibility of HPR in IPM. Advantages and Disadvantages of HPR. Examples of resistant varieties in major crops.
10. Biological methods- classical biological control, merits and limitations, Parasitoids and Predators – definition - difference between a predator and a parasitoid - Types of parasitoids - Types of parasitism.
11. Important families of predators and parasitoids and their role in pest management.
12. Microbial control – definition, Important groups of microbial agents, Mode of action and symptoms of pathogenicity. Their role in pest management.
13. Legal methods of pest control - Important provisions, Plant Quarantine, Insecticides Act 1968 – Invasive insect pest.
14. Traps in crop and storage pests management. Push and Pull techniques.
15. Pheromones in IPM – Sex pheromones, Alarm pheromones, trail pheromones and aggregation pheromones
16. Allelochemicals in IPM -Allomones, Kairomones and Synomones. Insect growth regulators in IPM – Moulting inhibitors and JH mimics.
17. **Mid Semester Examination**
18. Biotechnology in IPM – genetic engineering – transgenic crops – Constraints in using transgenic crops. Sterile male technique and gamma radiation in IPM.
19. Mass multiplication and application techniques of important groups of Parasitoids and Predators.
20. Mass multiplication and application techniques of important Entomopathogenic Viruses, Bacteria, Fungi and nematodes.
21. Conservation, importation, augmentation and release of natural enemies.
22. Role of birds in insect and rodent management.
23. Botanical insecticides in IPM – Neem and other examples. Antifeedant, Repellent and Insect growth disturbance properties of botanicals.
24. Formulation techniques of Botanicals. Traditional methods in IPM.
25. Chemical control – importance and history. Classification of pesticides – different modes of classification.
26. Toxicity ranges. Basic and newer Formulations of insecticides.
27. Hazards of insecticides - Symptoms of poisoning, first aid and antidotes.
28. Insecticide residues, insecticide resistance, Insect resurgence, insecticide contamination and pollution, bio accumulation and bio magnification. Compatibility and Phytotoxicity.
29. Newer insecticides in pest management. Insecticide resistance and residue management.

30. Integrated pest management strategies for Rice, cotton, sugarcane and coconut.
31. Important species of pollinators – Bee pollination, caprifigation.
32. Important species of weed killers and scavengers and their importance.
33. Harmful insects on Animals - Cattle and poultry pests
34. Household pests, vectors of human diseases and insects causing annoyance.

### **PRACTICAL SCHEDULE**

1. Characterization of terrestrial /pond ecosystems and preparation of charts.
2. Observation on types of damage and major symptoms caused by insect pests.
3. Practicing various sampling techniques and assessment of insect population and their damage in field/horticultural crops.
4. Practicing Pest surveillance through light traps/ pheromone traps and forecasting of field incidence.
5. Practicing common Cultural, Mechanical and Physical methods in pest management.
6. Analysing distinguishing characters of few resistance varieties of important crops.
7. Observation on models of traps in pest management – Pheromone traps, light traps, sticky traps and other traps.
8. Identification of different types of parasitoids, predators and entomopathogens.
9. Practicing Mass culturing techniques of *Trichogramma* and *Chrysopa*.
10. Practicing Mass production of NPV and Fungal pathogens.
11. Studies on models of bird perches, owl nesting and placement. Preparation of Botanical formulations. Practicing few Traditional methods of pest management.
12. Identification of different groups of pesticide formulations.
13. Recognizing label information, Precautions in pesticide applications, First aid and antidotes informations. Identification of types of Pesticide application equipments and practicing of application of insecticides.
14. Preparations of spray fluids for field application. Calculation of doses/concentrations of insecticides. Observation on compatibility of pesticides and Phytotoxicity of insecticides. Effective application of insecticides.
15. Identification of Important species of pollinators, weed killers and scavengers, Cattle, poultry and household pests.
16. Identification of vectors of human diseases and insects causing annoyance.
17. **Final Practical examination**

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1. Dhaliwal, G.S. and Ramesh Arora. 1998. Principles of Insect Pest Management. Kalyani Publishers, New Delhi. 395p.
2. Jain, P.C. and M.C. Bhargava. 2007. Entomology – Novel approaches. New India Publishing agency, New Delhi. 533 p.
3. Koul, O., G. S. Dhaliwal and G.W. Cuperus. 2004. Integrated pest management: potential, constraints and challenges, CABI Publishing Series 329 p.
4. Rao, V., Umamaheswari and R. Prasad. 2010. Integrated Insect Pest Management. Agrobios, Jodhpur. 266 p.
5. Srivastava, K.P. 2003. A text book of Applied Entomology. Vol. I & II. Kalyani Publishers. 257p and 319p.

## **PAT 314 DISEASES OF FIELD CROPS (1+1)**

### **OBJECTIVES**

The subject covers etiology, symptoms, mode of spread, survival, epidemiology and management of the diseases of the cereals, millets, pulses, oil seeds and cash crops.

### **THEORY**

#### **Unit I: Diseases of Cereals and Millets**

Rice, Wheat, Barley, Oats and Maize. Sorghum. - Bajra, Pearl millet and minor millets.

#### **Unit II: Diseases of Pulses**

Pigeonpea, Urdbean, Mung Bean, Chickpea, Soybeans, Field Bean and Cowpea.

#### **Unit III: Diseases of Oilseeds**

Groundnut, Mustard, Sesame, Sunflower, Safflower, Castor, Linseed and Jatropha

#### **Unit IV: Diseases of cash crops**

Cotton, Jute, Sugarcane, Sugar beet, Tobacco and Mulberry.

#### **Unit V: Fungal spoilage of grain**

Spoilage of grain during storage and their managementS.

### **PRACTICAL**

Study of symptoms and host-parasite relationship of- Rice, wheat, barley, oat, maize and sorghum, pearl millet, ragi and minor millets- Pigeonpea, urdbean, mungbean, chickpea, field bean - groundnut. Gingelly, castor, sunflower, linseed, safflower mustard, cotton, jute, sugarcane, sugar beet, tobacco, jatropha and mulberry.

### **THEORY SCHEDULE**

1. Fungal, bacterial, viral and phytoplasma diseases of rice.
2. Diseases of wheat, barley and oats
3. Diseases of maize
4. Diseases of sorghum and pearl millet
5. Diseases of ragi (finger millet), minor millets
6. Diseases of pulses pigeonpea, urdbean, mungbean
7. Diseases of pulses – chickpea, field bean and soybean
8. Mid semester examinations
9. Diseases of groundnut
10. Diseases of gingelly and castor
11. Diseases of linseed and mustard
12. Diseases of sunflower, safflower & jatropha
13. Diseases of cotton and jute.
14. Diseases of sugarcane and sugarbeet.
15. Diseases of tobacco and mulberry
16. Spoilage of grains by field fungi and managements
17. Fungal spoilage of grains during storage and managements

### **PRACTICAL SCHEDULE**

Study of diseases symptoms and host-parasite relationship of:

1. Rice
2. Wheat
3. Maize
4. Sorghum
5. Pearl millet
6. Ragi
7. Minor millets.
8. Field visit
9. Pigeonpea
10. Urdbean, mungbean, chickpea, field bean and so
11. Groundnut
12. Gingelly
13. Castor and sunflower linseed, safflower and Mustard
14. Cotton and jute.
15. Sugarcane and sugar beet
16. Tobacco, jatropha and mulberry.
17. Final Practical examinations

**Assignment:** Students should submit 50 well preserved diseased specimens

### **REFERENCES**

1. Mehrota, R.S. 1980. Plant Pathology, Tata Mc Grow Mill Pub. Co., New Delhi, pp. 771.
2. Nene, Y.L. and Thapliyal, P.N. 1998. Fungicides in Plant Disease Control. Oxford and IBH publishing Co. Ltd., New Delhi.
3. Prakasam, V., Valluvaparidasan, V., Raguchander, T. and K.Prabakar. 1997. Field Crop Diseases, AE Publication, Coimbatore.
4. Rangaswami, G. 2005. Diseases of Crop Plants in India. Prentice Hall of India Pvt. Ltd., New Delhi pp. 504.
5. Singh, R.S. 1993. Plant Diseases, Oxford & IBH Publication, New Delhi.

## **GPB 315: PRINCIPLES OF PLANT BIOTECHNOLOGY (2+1)**

### **OBJECTIVES**

- To teach various aspects of plant tissue culture
- To familiarize recent strides in molecular genetics, gene transformation and immunotechnology

## **THEORY**

### **Unit I: Basics in Plant Tissue Culture**

History and concepts, Nutritional requirements, Morphogenesis-organogenesis and embryogenesis, Tissue culture techniques-Callus and suspension cultures, shoot tip and meristem tip culture, anther and pollen culture, endosperm culture and protoplast culture. Micropropagation – achievements. Meristem culture and production of virus free plants – protoplast isolation and fusion. Somatic hybrids. Somaclonal variation, synthetic seeds – doubled haploids. National certification system for Tc Plants. *In vitro* germ plasm conservation.

### **Unit II: Molecular Genetics**

Structure of nucleic acids- central dogma of life - DNA replication, protein synthesis, fine structure of a gene, regulation of gene expression, reaction, polymerase chain reaction, blotting techniques, DNA sequencing methods. DNA markers – different kinds – Hybridization based RFLP – PCR based markers – AFLP, RAPD, SSR and SNPs – DNA finger printing of varieties – gene tagging – marker assisted selection and its application in crop improvement.

### **Unit III: Recombinant DNA Technology**

Recombinant DNA, vectors: plasmids, phagemids, cosmids, BAC and YAC. DNA manipulation enzymes - polymerase, restriction endonucleases and ligases - construction of recombinant DNA molecules - Bacterial transformation. Transgenic plants for biotic and abiotic stress resistance and quality improvement – current status at national and international level. Detection of Gmos – biosafety and bioethics.

### **Unit IV: Genetic Transformation**

Design of plant transformation vectors-selectable markers, reporter genes, promoters. Methods of gene transfer-direct: microinjection, electroporation, particle bombardment, indirect gene transfer - *Agrobacterium* mediated gene transfer. Plants as bio-factories – production of vaccines, therapeutic proteins, industrial enzymes and bioplastics.

### **Unit V: Immunotechnology and Bioprospecting**

Antigens, antibodies and their structure, antigen-antibody interaction, monoclonal and polyclonal antibodies. Production of secondary metabolites – callus and cell suspension culture, bioreactors for plant cell culture.

## **PRACTICAL**

Laboratory organization –sterilization techniques-Preparation of MS medium - Inoculation of explants - shoot tip and embryo culture- micro propagation of banana and roses. Meristem culture of cassava – virus indexing Extraction of plasmid and plant genomic DNA. DNA Quantification -quality assessment. Electrophoresis of DNA. Restriction digestion, ligation, competent cell preparation, bacterial transformation, blue white colony screening. *Agrobacterium* mediated transformation and confirmation of genetic transformants- PCR. – DNA markers – hybridization and PCR based markers. DNA finger printing of varieties and gene tagging, marker assisted selection and its application in crop improvement.

## **THEORY SCHEDULE**

1. History and concepts in plant tissue culture- totipotency, dedifferentiation and redifferentiation
2. Nutritional requirements for plant tissue culture
3. Morphogenesis- direct and indirect organogenesis and embryogenesis
4. Callus and suspension culture, shoot tip and meristem tip culture
5. Anther and pollen culture and ovule culture – production of haploids
6. Embryo, endosperm and protoplast culture.
7. Micropropagation of commercially viable crops – Banana and ornamental plants.
8. Meristem culture and production of virus free plants – Disease detection and indexing – PCR and ELISA.
9. Protoplast isolation and fusion – production of somatic hybrids
10. Synthetic seeds, somaclonal variation and application.
11. Herbicide tolerant, biotic stress resistant transgenic plants – pests and disease resistant.
12. Abiotic stress resistant transgenic plants – drought, salinity and temperature.
13. Transgenic plants engineered for quality traits – enhancement of nutrition quality, shelf life.
14. Structure of nucleic acids
15. Central dogma of life DNA replication
16. Protein synthesis
17. Fine structure of gene – r<sup>II</sup> locus.
- 18. Mid- Semester examination**
19. Gene regulation in prokaryotes – lac operon.
20. Polymerase chain reaction
21. Blotting techniques
22. DNA sequencing methods

23. Recombinant DNA, Vectors – plasmids, phagemids, BAC, YAC.
24. DNA manipulation enzymes – polymerase, restriction endonucleus and ligases.
25. Construction of recombinant DNA moleculars and bacterial transformation
26. Design of plant transformation vectors – selectable markers and reporter genes, promoters.
27. Methods of gene transfer- micro injection, electroporation, particle bombardment.
28. *Agrobacterium* mediated gene transfer
29. Detection of GMOs Indian regulatory guidelines, biosafety and bioethics
30. DNA markers – hybridization and PCR markers
31. DNA finger printing of varieties and gene tagging
32. Marker assisted selection and its application in crop improvement.
33. Plants as biofactories – production of recombinant proteins – vaccines, therapeutic proteins, industrial enzymes and bioplastics.
34. Discovery of novel compounds from plants- importance of secondary metabolites - Callus and cell suspension culture, bio reactors for plant cell culture.

### **PRACTICAL SCHEDULE**

1. Laboratory organization and sterilization techniques
2. Preparation of MS medium and Inoculation of explant -shoot tip
3. Micro propagation of Banana
4. Meristem culture of tapioca
5. Transformation of tobacco and analysis of transgenic plants – PCR.
6. Visit to Bt cotton field and strip assay for detection of Cry protein.
7. Extraction of genomic DNA
8. Isolation of plasmid DNA from bacteria
9. Quantification of DNA by spectrophotometer
10. Genomic DNA visualization using agarose gel electrophoresis
11. DNA fingerprinting using RAPD primers
12. Hybrid identification using SSR marker
13. Restriction digestion and ligation
14. Competent cell preparation
15. Bacterial transformation and blue white colony screening
16. Analysis of PCR products in agarose gel electrophoresis
17. Practical Examination.

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1. Bhojwani, S.S. and Razdan, M.K. 2006. Plant Tissue Culture Studies – Theory and Practice. Elsevier Publication. Netherlands.
2. Gupta, P.K. 2005. Elements of Biotechnology. Rastogi Publication, India.
3. Malacinski, M. and D. Friefelder. 2003. Essentials of molecular biology. IV Ed. Jones and Bartlett publishers, Boston
4. Singh, B.D. 2004. Frontier areas in Biotechnology. Kalyani Publications, New Delhi.
5. Brown, T.A. 2006. Gene cloning - An introduction. V Ed. Chapman Hill, U.K.

## **HOR 316 PRODUCTION TECHNOLOGY OF SPICE, AROMATIC AND MEDICINAL CROPS (1+1)**

### **OBJECTIVES**

This subject deals with scope and importance of spice, aromatic and medicinal crops, their cultivation aspects and post harvest management practices.

### **THEORY**

#### **Unit I: Scope and importance of spice, Aromatic and Medicinal Crops**

Spice, Aromatic and Medicinal Crops – History of medicinal plant cultivation in India.-scope and importance – Current status of area and production – Nutraceutical value – classification of spices - state, national and international scenario on commercial spices production – global competitiveness-importance of GAP and organic spice production.

#### **Unit II: Crop production techniques in spice crops**

Soil and Climate - varieties and related species – propagation and planting – training and pruning practices - weed and water management – Nutrient management - including drip and fertigation – harvest.

**Crops:** Black pepper, cardamom, turmeric, ginger, garlic, coriander, fenugreek, cumin, fennel, clove, nutmeg, cinnamon tamarind and vanilla.

#### **Unit III: Production technology of medicinal crops**

Medicinal crops- importance and scope – current status - *ex-situ* and *in-situ* conservation – GAP and organic production and certification - soil and climate – varieties – propagation– planting methods – nutrient, water and weed management – harvest – post-harvest handling – storage, packaging of senna, periwinkle, glory lily, ashwagandha, medicinal coleus, aloe, Isabgol, phyllanthus, medicinal dioscorea and medicinal solanum – extraction of secondary metabolites.

#### **Unit IV: Production technology of aromatic crops**

Aromatic crops - importance and scope – current status - *ex-situ* and *in-situ* conservation – GAP and organic production and certification - soil and climate – varieties – propagation– planting methods – nutrient, water and weed management – harvest – post-harvest handling – storage, packaging of ocimum, davana, mint, lemon grass, citronella, geranium, eucalyptus, palmarosa and vetiver – distillation of essential oils.

#### **Unit V: Post harvest technology of Spice, Aromatic and Medicinal Crops**

Importance of post harvest technology in Spice, Aromatic and Medicinal Crops. Pre cooling, grading, various methods of packing, packaging materials - vacuum packing, poly shrink packing. Cushioning materials for packing. Pre storage treatments, methods of storage - low temperature storage, controlled atmospheric storage, hypobaric storage, irradiation and low cost storage structures – value addition.

#### **PRACTICAL**

Identification of spices, medicinal and aromatic crops – propagation - seed treatment – sowing - planting - training and pruning – shade management - fixing maturity standards – harvesting - visit to spice gardens. Study of post harvest handling and processing of. Crops: Black pepper, cardamom, turmeric, ginger, garlic, coriander, fenugreek, cumin, fennel, clove, nutmeg, cinnamon tamarind and vanilla. senna, periwinkle, glory lily, ashwagandha, phyllanthus, medicinal coleus, aloe, medicinal dioscorea, medicinal solanum, ocimum, davana, mint, lemon grass, citronella, geranium, eucalyptus, palmarosa and vetiver – visit to commercial medicinal and aromatic plants fields and processing units

#### **THEORY SCHEDULE**

1. Spice, Aromatic and Medicinal Crops – scope and importance – History of medicinal plant cultivation in India - Current status of area and production —Nutraceutical value—classification of spices-
2. Global scenario on commercial spices production – export potential - importance of GAP and organic spice production.
3. Soil and Climate- varieties and related species – propagation and planting – training and pruning practices - weed and water management – Nutrient management- drip and fertigation – harvest of Black pepper and Cardamom
4. Do---turmeric, ginger, garlic, fenugreek and fennel
5. Do--- , cumin, clove and nutmeg
6. Do-- cinnamon tamarind and vanilla.
7. Importance of post harvest technology, maturity indices, harvesting and post harvest handling of spices.
8. **Mid Semester Examination.**
9. Varieties – soil and climate – propagation- sowing and planting, nutrient, water and weed management - harvest, and processing – post harvest handling of Senna, periwinkle
10. Ashwagandha ,Medicinal coleus, aloe -
11. Gloriosa, Isabgol, Medicinal Solanum and Medicinal Dioscorea
12. Methods of extraction of secondary metabolites from medicinal plants
13. Ocimum, davana and Mint -
14. Citronella, Lemon grass and Vetiver
15. Geranium and Palmarosa -Eucalyptu
16. Methods of distillation of essential oil from aromatic crops
17. Post harvest processing and value addition in medicinal crops.

#### **PRACTICAL SCHEDULE**

1. Turmeric and ginger – processing and curing
2. Pepper – description of varieties, study of different shoots, propagation and varieties
3. Cardamom - description of varieties, propagation, shade management and processing
4. Coriander and Fenugreek – Study on varietal identification – seed treatment – sowing and harvest.
5. Clove and Nutmeg - description of varieties, propagation, training, pruning and processing
6. Cinnamon and Tamarind - description of varieties, propagation, training, pruning and processing
7. Visit to tree spice gardens
8. Study of post harvest handling and processing in spices
9. Identification of medicinal and aromatic plants – study on economic parts used and their products



10. Propagation techniques of senna and periwinkle, glory lily, aswagandha and phyllanthus.
11. Propagation techniques of medicinal coleus, isabgol and aloe.
12. Propagation techniques of medicinal Dioscorea, and Solanum
13. Identification of species/varieties and propagation techniques of ocimum, eucalyptus
14. Identification of species/varieties and propagation techniques of davana and mint.
15. Identification of varieties and propagation techniques of lemon grass, palmarosa, vetiver, citronella and geranium
16. Visit to commercial medicinal and aromatic plants fields and processing units
- 17. Final Practical Examination**

## REFERENCES

1. Thamburaj, S. and Narendra Singh .2001. Vegetables, Tuber crops and Spices, Directorate of information and publications of agriculture, ICAR, New Delhi.
2. Kumar, N. Md. Abdul Khader, P.Rangasamy, and I. Irulappan, 2001. Spices, Plantation Crops, Medicinal and Aromatic Plants, Rajalakshmi Publications, Nagercoil.
3. Bhattacharjee, S.K., 2004. Hand book of medicinal plants, Pointer publications, Jaipur.
4. Bose, T.K., Yadav, L.P., Pal. P., Parthasarathy, V.A., Das. P., 2003. Commercial flowers. Vol. I and II. Naya udyog, Kolkata-6.
5. Ravindrasharma (2004) Agro techniques of Medicinal plants. Daya publishing, New Delhi.
6. Trivedi, P.C. (2004) Medicinal Plants: Utilization and Conservation, Aavishkar Publisher, Distributors, Jaipur.
7. Farooqi, M., M. M. Khan and M. Vasundhara. 2004. Production technology of medicinal and aromatic crops. Natural Remedies Pvt. Ltd., Bangalore – 561229.
8. Kumar, N. Introduction to Spices, Plantation, Medicinal and Aromatic crops. 1995. Oxford and IBH Publications, New Delhi.

## AEC 317 INTRODUCTIONS TO AGRIBUSINESS MANAGEMENT (1+1)

### OBJECTIVES

The objective of this course is to impart skill, training, proficiency in decision making and enhance ability, to direct, to coordinate and control the work at all levels of management for the farm graduates.

### THEORY

#### Unit I Agribusiness

Agribusiness – definition – structure of agribusiness (input, farm and product sectors) agribusiness management - special features of agribusiness - importance of agribusiness in Indian economy.

#### Unit II Management

Management – definition and importance – Management functions: Nature. management - skills, levels and functional areas of management. Forms of business organisation – sole proprietorship – partnership – private and public limited, cooperatives.

#### Unit III Management Functions I

Planning – definition – types of plans (Purpose or Mission, Goals or Objectives, Strategies, Policies, Procedures, Rules, Programmes, Budget). Steps in planning – characteristics of Sound plan. Objectives – MBO – principles of organizing – concept of departmentation –delegation - centralization – decentralization.

#### Unit IV Management Functions II

Staffing – concept – human resource planning – process. Directing – concept – Principles – techniques, supervision. Motivation – concept - Maslow’s need hierarchy theory – types – techniques. Communication – definition and process – models – types – barriers. Leadership – definition – styles – difference between leadership and management

#### Unit V Management Functions III

Controlling – concept - steps – types – importance – process. Functional areas of business – operations, human resources, finance and marketing – scope and meaning. Laws and policies related to agri-business.

### PRACTICAL

Exercise on operations management in agribusiness firms - logistics management - inventory management - inventory types, costs and economic order quantity - ABC analysis - procurement systems and vendor rating methods - exercise on supply chain management. Market research and

segmentation - demand forecasting methods - farmers survey – buying behaviour of agricultural inputs - market promotion measures - pricing methods. Exercises on human resource planning and management. Assessing and acquiring finance for agribusiness firms- Visit to agri hi-tech bank branch / commercial banks/RRB/ NABARD. Procedure and constraints in establishing agro based industries-New agribusiness venture proposal preparation

### **THEORY SCHEDULE**

1. Agribusiness – definition – structure of agribusiness (input, farm and product sectors).
2. Agribusiness management - special features of agribusiness - importance of agribusiness in Indian economy.
3. Management – definition and importance – management functions. Management – Skills, levels and functional areas of management.
4. Forms of business organisation – sole proprietorship – partnership – private and public limited, cooperatives.
5. Planning – definition – types of plans (purpose or mission, goals or objectives, strategies, policies, procedures, rules, programmes, budget)
6. Steps in planning – characteristics of sound plan. Objectives – MBO
7. Organizing – principles of organizing – organisation structure – formal and informal Organisation
8. Concept of departmentation- span of control – authority and responsibility concept and meaning. Delegation- centralization – decentralization
9. **Mid Semester Examination**
10. Staffing – concept – human resource planning – process.
11. Directing – concept – principles – techniques, supervision.
12. Motivation – concept - Maslow’s need hierarchy theory – types – techniques.
13. Communication – definition and process – models – types – barriers
14. Leadership – definition – styles – difference between leadership and management
15. Controlling – concept - steps – types – importance – process.
16. Functional areas of business – operations, human resources, finance and marketing – scope and meaning
17. Laws and policies related to agri-business.

### **PRACTICAL SCHEDULE**

1. Exercise on operations management in agribusiness firms
2. Logistics management
3. Inventory management - inventory types, costs and economic order quantity
4. Procurement systems and vendor rating methods
5. ABC analysis
6. Exercise on supply chain management
7. Market research and segmentation
8. Demand forecasting methods
9. Visit to agri hi-tech bank branch / commercial banks/RRB/ NABARD
10. Exercises on human resource planning and management
11. Farmers survey – buying behaviour of agricultural inputs
12. Market promotion measures
13. Pricing methods
14. Assessing and acquiring finance for agribusiness firms
15. Procedure and constraints in establishing agro based industries
16. New agribusiness venture proposal preparation
17. **Final practical examination**

### **REFERENCES**

1. Aswathappa, K, 2008, Human Resource Management: Text and Cases, Tata McGraw-Hill Pub. Co. Ltd. New Delhi, 5th Edition.
2. Chandra Prasanna. 2000. Financial Management - Theory and Practice. Tata Mc Graw Hill Publishing Company Ltd., New Delhi
3. Prasad, L.M, 2005, Principles and Practices of Management, Sultan Chand and Sons Educational Publishers, New Delhi
4. Philip Kotler, 2003, Marketing Management, Pearson Education, India.
5. Richard, B Chase, Nicholas J., Acquilano and F.Robert Jacobs, 2007, *Production and Operations Management - Manufacturing and Service*, Tata Mc Graw Hill Publishing Company Limited, New Delhi.

## OBJECTIVES

- To impart knowledge on entrepreneurship and its importance in socio-economic development of the nation.
- To gain knowledge and skills in project formulation, project report preparation and evaluation of projects.

## THEORY

### Unit I : Concept of Entrepreneurship

Concept of entrepreneur, entrepreneurship, functions of entrepreneur. Entrepreneurial characteristics -distinction between an entrepreneur and a manager. Agri entrepreneurship - concept, need and scope.

### Unit II: Entrepreneurship Development Programmes

Assessing overall business environment in Indian economy – globalization – implications of social, political and economic systems on entrepreneurship. Entrepreneurship Development Programmes (EDPs) - objectives, phases, problems of EDPs, criteria for assessment or evaluation of EDPs. Generation, incubation and commercialization of business ideas.

### Unit III: Management of Enterprises

Role of entrepreneurship in economic development. Motivation and entrepreneurship development. Managing an enterprise - Importance of planning, budgeting, monitoring, evaluation and follow up in running an enterprise. Managing competition - ways to define possible competitors, competitive information. SWOT analysis-concept, meaning and advantages.

### Unit IV: Marketing and Record Keeping

Venture capital – concept, aims, features, financing steps sources, criteria to provide venture capital. Marketing - market segmentation, market positioning, marketing mix and product mix. Record keeping – purpose, needs and types of records to be maintained in an enterprise. Forms of business – contract farming, joint ventures and public private partnerships. Social responsibility and business ethics.

### Unit V: Government Schemes for Entrepreneurship

Project – meaning – importance – components and preparation. Government schemes and incentives for promotion of entrepreneurship and government policy on small and medium enterprises. Women entrepreneurship-concept, problems and development of women entrepreneurs.

## THEORY SCHEDULE

1. Concept of entrepreneur, entrepreneurship and functions of an entrepreneur
2. Entrepreneurial characteristics – distinction between an entrepreneur and a manager – Agri-entrepreneurship- – concept need and scope
3. Assessing overall business environment in Indian economy – globalization – implications of social, political and economic systems on entrepreneurship.
4. Entrepreneurship Development Programmes (EDPs) – objectives, phases, problems of EDPs, criteria for assessment or evaluation of EDPs
5. Generation, incubation and commercialization of business ideas
6. Role of entrepreneurship in economic development, motivation and entrepreneurship development, managing an enterprise
7. Importance of planning, budgeting, monitoring, evaluation and follow up in running an enterprise
8. Managing competition – ways to define possible competitors, competitive information, SWOT analysis-concept, meaning and advantages
9. **Mid-Semester Examination**
10. Venture capital – concept, aims, features, financing steps sources, criteria to provide venture capital
11. Marketing - market segmentation, market positioning, marketing mix and product mix
12. Record keeping – purpose, needs and types of records to be maintained in an enterprise
13. Forms Business – contract farming, joint ventures and public private partnerships.
14. Social responsibility and business ethics
15. Project – meaning – importance – components and preparation
16. Government schemes and incentives for promotion of entrepreneurship and government policy on small and medium enterprises
17. Women entrepreneurship-concept, problems and development of women entrepreneurs.

## PRACTICAL SCHEDULE

1. Steps in formulating a project proposal
2. Field visit to successful agri-enterprise – study of characteristics of successful agripreneurs – case study
3. Working out Benefit – Cost Ratio for any agro based enterprise
4. Working out Break even analysis

5. Working out various financial ratios
6. Capital budgeting for any agro based enterprise
7. Preparation of balance sheet for an enterprise
8. Practicing tower building
9. Practicing test for achievement planning
10. Visit to agri clinics and agri business centers
11. Case study of successful Women entrepreneurs
12. Preparation of a sample project proposal for an agro based enterprise
13. SWOT analysis of selected enterprise
14. Development of project proposals – formulation of project plan – I
15. Development of project proposals – formulation of project plan – II
16. Presentation of project reports by the students – I
17. Presentation of project reports by the students – II

## REFERENCES

1. Gupta, C.B. 2001. Management: Theory and Practice. Sultan Chand and Sons, NewDelhi.
2. Khanka, S.S.1999. Entrepreneurial Development. S. Chand and Co., New Delhi.
3. Sagar Mondal and Ray, G.L. 2009. Text Book of Entrepreneurship and Rural Development, Kalyani Publishers, Ludhiana.
4. Vasant Desai. 1997. Small Scale Industries and Entrepreneurship. Himalaya Publishing House, New Delhi.
5. Vasant Desai. 2000. Dynamics of Entrepreneurial Development and Management, Himalaya Publishing House, New Delhi.

## ENG 319 COMPREHENSION AND COMMUNICATION SKILLS (1+1)

### OBJECTIVES

To enable the learner acquire the major skill -- listening, reading, speaking and writing --practice integrating all the skills for requires needs specific and general -asses the progress of comprehension and expression

### THEORY

#### Unit – I

Education – employment – unemployment – when is a person unemployed – applications – applying for a job- planning – A good job with prospects – Curriculum Vitae - word building – articles.

#### Unit – II

Interview – taking part in interviews - role play – word hunt – Look alike words – sound alike words – Rhyming words – Reporting – After the interview –General Knowledge – Quizzes – Review - Stress – Poem reading – No time - reported speech

#### Unit – III

Killers – Comprehension on cigarettes and sudden death – drugs and Youth - Galloping growth – A short story – Judging a story – Environment – Polluting the world – A dead planet – Is there life on earth - tenses

#### Unit – IV

Riddles – Puzzles in nature – Qahwah – All about coffee – A dilemma lesson – Computeracy – Review - phrases and clauses.

#### Unit - V

Entertainment – How to be entertaining – You and your English – reading, comprehension and answering the questions – Usage and abusage – War minus showing – A lesson from the text book “The sporting spirit” – Who’s who - fun with language.

### THEORY LECTURE SCHEDULE

1. Education – Are you a clean slate – employment – unemployment – when is a person unemployed
2. Applications – applying for a job - A good job with prospects
3. Curriculum Vitae – Writing own Curriculum Vitae -word building – articles.
4. Interview – taking part in interviews - role play
5. Word hunt – Look alike words – sound alike words – Rhyming words
6. Reporting – After the interview –improve your General Knowledge – review – super toys
7. Stress – The rat race - Poem comprehension – on No time - reported speech
8. Killers – Comprehension on cigarettes and sudden death – drugs and Youth – hints developing
9. Mid semester Examination
10. Galloping growth – population – expulsion – A short story - Judging a story
11. Environment – polluting the world – A dead planet - Is there life on earth - tenses
12. Riddles – Puzzles in nature – Qahwah – All about coffee – Coffee discovery -phrases and clauses.

13. A dilemma lesson – a layman looks at science by Ramond B. Fostick – Comprehension pertaining
14. Computeracy – Computers by Peter Laurie – Review – use your English
15. Entertainment – How to be entertaining – You and your English – A lesson from the text book by G.B.Shaw
16. Usage and abusage
17. War minus showing – A lesson from the text book “The sporting spirit” – fun with language.

### **PRACTICAL SCHEDULE**

1. Effective Listening – Developing Listening Skills – Honing Listening skills
2. Listening to short talks and Lectures from the cassettes of EFL University
3. Spoken English, Vowels, consonants, monophthongs, diphtongs, triphthongs
4. Stress, intonation, phonetic transcription
5. Seminars, Conferences, preparation and demonstration
6. Oral Presentation by students, Articulation and delivery – Evaluation sheet for oral presentation
7. Communication skills – Verbal communication, written communication
8. Telephonic conversation
9. Reading Skills, Skimming, Scanning, Extensive reading, Intensive reading examples
10. Meeting, purpose, procedure, participation, physical arrangements
11. Presentation of reports by using power point & L.C.D
12. Interviews – Mock interviews
13. Debate and Group discussion
14. Using a dictionary effectively
15. Vocabulary
16. Pronunciation practice
17. Practical examination.

### **Prescribed Text book**

1. Krishnaswamy, N. and Sriraman, T. 2007. *Current English for Colleges*. Macmillan Indian Ltd., Chennai.

### **REFERENCES**

1. Balasubramanian T. 1989. *A Text book of Phonetics for Indian Students*, Orient Longman , New Delhi
2. Balasubramanyam M. 1985. *Business Communication*, Vani Educational Books, New Delhi
3. Jean Naterop, B. and Rod Revell 1997. *Telephoning in English* Cambridge University Press, Cambridge
4. Krishna Mohan and Meera Banerjee 1990. *Developing Communication Skills*, Macmillan India Ltd. New Delhi.
5. Narayanaswamy V R 1979. *Strengthen your writing*, Orient Longman, New Delhi
6. Sharma R C and Krishna Mohan 1978. *Business Correspondence*, Tata Mc Graw Hill publishing Company, New Delhi

## **SEMESTER VI**

### **AGR 321: WEED MANAGEMENT (1+1)**

#### **OBJECTIVES**

- Basic understanding on the biology and ecology of weeds. Equipping with the concepts and principles of weed control and management
- Exposure to different scientific advancements in the field of weed science.

#### **THEORY**

##### **Unit I: Weed biology and ecology**

Weeds: Introduction, Definitions; harmful and beneficial effects, classification, propagation and dissemination; Seed dormancy- Crop weed competition and allelopathy.

##### **Unit II: Principles of weed control**

Concepts of weed prevention, control and eradication; Methods of weed control: physical, cultural, chemical, biological and biotechnological methods. Integrated weed management.

##### **Unit III: Chemistry of Herbicides**

Herbicides: advantages and limitation of herbicide usage in India, Herbicide classification, formulations, methods of application; Introduction to Adjuvants and their use in herbicides;

##### **Unit IV: Herbicides physiology**

Introduction to selectivity of herbicides; Herbicide absorption and translocation; Compatibility of herbicides with other agro chemicals, Herbicide residue management and Herbicide resistance

##### **Unit V: Weed management**

Weed management in major field and horticultural crops, aquatic and problematic weeds and their control, invasive alien weeds.

### **PRACTICAL**

Identification of weeds; Survey of weeds in crop fields and other habitats; Preparation of herbarium of weeds; Calculations on weed control efficiency and weed index; Herbicide label information; Computation of herbicide doses; Study of herbicide application equipment and calibration; Demonstration of methods of herbicide application; Preparation of list of commonly available herbicides; Study of phytotoxicity symptoms of herbicides in different crops; Biology of nut sedge, bermuda grass and parthenium; Economics of weed control practices; Tours and visits of problem areas.

### **THEORY LECTURE SCHEDULE**

1. Weeds – Definition, classification and characteristics, harmful and beneficial effect of weeds.
2. Classification and characteristics of weeds of different agro ecosystems-lowland weeds, irrigated upland and rainfed land weeds.
3. Classification and characteristics of weeds – Aquatic, parasitic and obnoxious weeds.
4. Life cycle of weeds, weed migration, weed seed distribution, dormancy, germination, establishment and perennation of weeds in different ecosystems.
5. Seed dormancy
6. Crop weed interactions - Critical crop weed competition, competitive and allelopathic effects of weeds and crops.
7. Principles and methods of weed management: Preventive, cultural, mechanical .
8. Principles and methods of weed management: chemical, biological and alternate methods
9. **Mid semester examination**
10. Classification and characteristics of herbicides and herbicide formulations – History and Development.
11. Herbicide Use Efficiency - Adjuvants, herbicide protectants and antidotes - Herbicide and herbicide mixtures in India – Interaction with moisture, fertilizer and other agrochemicals.
12. Mode of action of herbicides and their selectivity - Mechanism of action of herbicides and their selectivity.
13. Herbicide persistence and degradation in plants and soils-Herbicide residue and management.
14. Herbicide resistant weeds and their impact on weed management.
15. Success of Herbicide Resistant Crops (HRC) in Indian and World agriculture.
16. IWM in crops and cropping systems-Agricultural Crops, Horticultural Crops.
17. Invasive alien weeds.

### **PRACTICAL SCHEDULE**

1. Identification, classification and characterization of terrestrial weeds
2. Identification, classification and characterization of Aquatic weeds
3. Identification, classification and characterization of problem and parasitic weeds
4. Weed survey and weed vegetation analysis- density, frequency, SDR and IVI
5. Study on biology of nut sedge, bermuda grass, Parthenium and Celosia;
6. Practicing Skill development on cultural and non chemical weed management
7. Identification, classification and characterization of herbicides
8. Practicing Skill development on herbicide application techniques
9. Practicing Skill development on spray equipment's and spray fluid calibration
10. Practicing Skill development on herbicide weed management in lowland, upland and rainfed ecosystems
11. Calculation of herbicide quantity and recommendation for different eco systems
12. Study on phytotoxicity symptoms of herbicides in different crops;
13. Calculations on weed control efficiency
14. Calculations on weed index
15. Herbicide residue determination by bioassay techniques
16. Economic analysis of different weed management methods in crops and cropping systems
17. **Practical Examination**

### **REFERENCES**

1. Das. T.K., 2008. Weed Science Basics and Applications. Jain brothers, New Delhi.
2. Gupta, O. P. 2000. Modern Weed Management. Agro Botanica Bikaner, India.
3. Walia. U.S. 2006. Weed Management, Kalayani Publishers, Ludhiana.

## OBJECTIVES

Organic agriculture course aims at incurring knowledge on various aspects of organic farming with relevance to its advantages and shortcomings against conventional high input agriculture, its importance in the present world scenario and its impact on environment and soil health.

## THEORY

### Unit – I: Importance of organic farming

Organic farming: Definition - Scope - principles and concepts - history of organic farming - global scenario – biodiversity: importance and measure to preserve biodiversity - pre requisites for Organic farming: Green revolution - definition – impacts, Natural resources and its management.

### Unit – II: Organic sources

Organic sources of nutrients – on farm and off farm sources – organic waste recycling-methods compost – compost making – Insitu and exsitu manuring - Soil and crop management - inter cropping, crop rotation, green manures, cover crops, mulching - bio fertilizers .

### Unit – III: Indigenous practices of organic farming

Indigenous– role of livestock – cow in organic farming – Panchagavya – Dasagavya – Amirthakaraisal – preparation – properties – general effects on crops..

### Unit – IV: Organic certification

Organic certification – NPOP guidelines - Certification agencies in India – crop production standards - Quality considerations - labeling and accreditation process - marketing and export opportunities – APEDA.

### Unit – V: Bio-intensive nutrient management

Bio-intensive nutrient management – application of Effective micro organism (EM) technology – phosphate rich organic manure (PROM). Weed management in organic farming - organic crop protection methods. Organic rice production – economic evaluation - benefits – organic enterprises.

## PRACTICAL

Raising of field crop – experiencing organic farming practices – soil, seed, nutrient, weed, water, pest and diseases, post-harvest management - hands on experience on bio composting, vermicomposting, ITK based biological preparations, bio-inoculants - quality analysis of inputs and products - grading, packaging, post-harvest management – visit to organic farms, market outlets and organic certification centers

## THEORY LECTURE SCHEDULE

1. Organic farming; definition – prospects- principles and concepts - History and genesis of organic farming in World and India: Present status in World, India and Tamil Nadu.
2. Introduction to bio-diversity; importance and measures to preserve bio-diversity.
3. Pre-requisites and basic steps for organic farming; conversation to organic farming – planning and processes in practices – Integration of animal components. Green revolution-definition-impacts-Natural resources and its management.
4. Sources of organic manures - plant, animal and microbial origin – on-farm resources; FYM, green manures, crop residues, poultry manure, sheep and goat manures, biogas slurry and vermicompost.
5. Off-farm resources; coir pith, pressmud, oilcakes, flyash, bio compost, minerals, bone meal, bio fertilizers, traditional preparations.
6. Organic waste recycling methods and techniques – composting, vermicomposting, *in situ* composting – system approach.
7. Soil and crop management in organic farming ;Inter cropping and companion planting, crop rotation , green manures and cover crops, mulching.
8. Indigenous practices of organic farming – role of livestock – cow in organic farming –
9. **Mid-Semester Examination**
10. Panchagavya – Dasagavya – Amirthakaraisal – preparation – properties – general effects on crops.
11. Organic certification – NPOP guidelines - Certification agencies in India.
12. Crop production standards - Quality considerations.
13. Labeling and accreditation process - marketing and export opportunities – APEDA
14. Bio-intensive nutrient management – application of Effective micro organism (EM) technology.
15. Phosphate rich organic manure (PROM).
16. Organic crop protection methods.– Weed management in organic farming.
17. Organic rice production -Economic evaluation - benefits – organic enterprises.

## PRACTICAL

1. Resource inventory of organic farm- Soil sampling and analysis for organic carbon and pesticide residues / contaminants.
2. Raising of green manures ( Sunnhemp / Daincha / Fodder cowpea).

3. Incorporation of green manure – seed treatment and raising of field crop (Rice / Maize/ Cowpea / Cotton / Gingelly).
4. Preparation of Panchagavya and Dasagavya
5. Preparation of amirdhakaraisal and vermicompost
6. Quantification of nutrients from organic sources and application of manures and bio-fertilizers.
7. Exposure visit to an organic farm to learn ITK based preparations.
8. Organic crop production and weed management.
9. Exposure visit to bio-pesticide and pheromone manufacturing units.
10. Organic crop production and pest management.
11. Exposure visit to bio-control agent (*Pseudomonas*, *Trichoderma* etc.,) production units
12. Organic crop production and diseases management.
13. Exposure on macro quality analysis of crop produces in laboratories
14. Hands on training on grading, packaging and post-harvest management.
15. Exposure visit to organic market out lets.
16. Exposure visit to organic certification agencies / Directorate of Organic Certification, Tamil Nadu.
- 17. Practical Examination**

## REFERENCES

1. Arunkumar Sharma 2008. A Hand book of organic Farming. Agrobios Publishers.
2. Dahama, A.K.2009. Organic Farming for Sustainable Agriculture, Agrobios publishers.
3. Palaniappan SP. and K.Annadurai. 2008. Organic Farming: Theory and Practice. Scientific Publishers.
4. Veeresh, G.K. 2010. Organic Farming, Cambridge University Press, India.

## ENT 323 PESTS OF CROPS AND STORED PRODUCE AND THEIR MANAGEMENT (2+1)

### OBJECTIVE

- To study the bionomics, symptoms of damage and management strategies of major pests

### THEORY

Bionomics, Symptoms of damage and Integrated management strategies for major insect and non-insect pests of following crops.

#### Unit I: Pests of Cereals, Millets and Pulses

Rice, Wheat, Maize, Sorghum, Cumbu, Ragi, Tenai, Redgram, Green gram, Black gram, Bengal gram, Cowpea and Soybean.

#### Unit II: Pests of Oilseeds, Cotton, Sugarcane, Green Manures, Forage Crops and Tobacco

Groundnut, Castor, Sesame, Sunflower, Safflower, Linseed, Jatropha, Mustard, Cotton, Sugarcane, Sunnhemp, Sesbania, Daincha. Glyricidia, Luceren, Subabul and Tobacco.

#### Unit III: Pests of Vegetables, Tubers, Spices and Plantations

Brinjal, Bhendi, Tomato, Crucifers, Cucurbits, Moringa and Amaranthus, Potato, Sweet potato, Yam and Tapioca, Chillies, Onion, Garlic, Ginger, Turmeric, Coriander, Curry leaf, Coconut, Arecanut, Coffee, Tea, Cashew, Rubber, Cocoa, Cardamom, Pepper and Betelvine.

#### Unit IV: Pests of Fruits, Ornamentals and Medicinal Plants

Mango, Sapota, Citrus, Banana, Grapevine, Guava, Jack, Custardapple, Pomegranate, Pine apple, Papaya, Ber, Apple, Rose, Jasmine, Crossandra, Chrysanthemum, Tuberose, Gloriosa, Coleus, Phyllanthus and Aswagantha.

#### Unit V: Pests of Tree, Lawn, Stored Products, Mushroom and green house crops

Neem, Teak, Tamarind, Sandalwood, Eucalyptus, Casuarina, lawn, turf, Cut flowers, Stored grains, Dry fruits and nuts, Mushroom and Green house crops. Non insect pests – Plant Mites, Plant Nematodes, Rodents, birds and other Vertebrates. Locusts and Insect vectors of plant diseases.

### PRACTICAL

Identification of symptoms of damage and life stages of important pests of different field and horticultural crops - cereals, millets, pulses, oilseeds, cotton, sugarcane, green manures, forage crops, tobacco, vegetables, tubers, spices, plantation crops, fruits, ornamentals, medicinal plants, trees, lawn, cut flowers and stored products. Identification of common phytophagous mites, plant parasitic nematodes, rodents and bird pests.

**Assignment:** Student has to rear and submit five insect pests of field and horticultural crops.

### THEORY LECTURE SCHEDULE

1. Pests of Rice - Leaf feeders and Borers
2. Pests of Rice – Sap feeders and Root feeders
3. Pests of Wheat, Maize, Sorghum, Cumbu, Ragi and Tenai
4. Pests of Redgram, Green gram, Black gram, Bengal gram, Cowpea and Soybean



5. Pests of Groundnut and Castor
6. Pests of Sesame, Sunflower, Safflower, Linseed, Jatropha and Mustard
7. Pests of Cotton - Leaf feeders and borers
8. Pests of Cotton - Sap feeders and Root feeders
9. Pests of Sugarcane - Leaf feeders and borers
10. Pests of Sugarcane - Sap feeders and Root feeders
11. Pests of Sunnhemp, Sesbania, Daincha. Glyricidia, Luceren, Subabul and Tobacco.
12. Pests of Brinjal, Bhendi and Tomato
13. Pests of Crucifers and Cucurbits
14. Pests of Moringa and Amaranthus
15. Pests of Potato, Sweet potato, Yam and Tapioca
16. Pests of Chillies, Onion, Garlic, Ginger, Turmeric, Coriander and Curry leaf
17. **Mid Semester Examination**
18. Pests of Coconut and Arecanut
19. Pests of Coffee and Tea
20. Pests of Cashew, Rubber and Cocoa
21. Pests of Cardamom, Pepper and Betelvine.
22. Pests of Mango, Sapota, Guava and Citrus
23. Pests of Banana, Grapevine, Jack and Custardapple
24. Pests of Pomegranate, Pine apple, Papaya and Ber, Apple
25. Pests of Rose, Jasmine, Crossandra and Chrysanthemum
26. Pests of Tuberose, Gloriosa, Coleus, Phyllanthus and Aswagantha.
27. Pests of Neem, Teak, Tamarind, Sandalwood, Eucalyptus and Casurina
28. Pests of lawn and cut flowers
29. Pests of stored grains, dry fruits and nuts
30. Pests of mushroom
31. Pests of green house crops. Locusts and their management.
32. insect vectors of plant diseases
33. Non insect pests – Plant Mites, Plant Nematodes
34. Non insect pests - Rodents, birds, other Vertebrates.

### **PRACTICAL SCHEDULE**

1. Identification of Pests of Rice
2. Identification of Pests of Wheat, Maize, Sorghum, Cumbu, Ragi and Tenai
3. Identification of Pests of Redgram, Green gram, Black gram, Bengal gram, Cowpea and Soybean
4. Identification of Pests of Groundnut, Castor, Sesame, Sunflower, Safflower, Jatropha and Mustard
5. Identification of Pests of Cotton
6. Identification of Pests of Sugarcane
7. Identification of Pests of Sunnhemp, Sesbania, Daicha. Glyricidia, Lucere, Subabul and Tobacco.
8. Identification of Pests of Brinjal, Bhendi, Tomato, Crucifers, Cucurbits, Moringa and Amaranthus
9. Identification of Pests of Potato, Sweet potato, Yam and Tapioca
10. Identification of Pests of Chillies, Onion, Garlic, Ginger, Turmeric, Coriander, Curry leaf, Coconut and Arecanut
11. Identification of Pests of Coffee and Tea
12. Identification of Pests of Cashew, Rubber, Cocoa, Cardamom, Pepper and Betelvine.
13. Identification of Pests of Mango, Sapota, Guava, Citrus, Banana, Grapevine, Jack, Custardapple, Pomegranate, Pine apple, Papaya, Ber and apple
14. Identification of Pests of Rose, Jasmine, Crossandra, Chrysanthemum, Tuberose, Gloriosa, Coleus, Phyllanthus and Aswagantha, Neem, Teak, Tamarind, Sandalwood, Eucalyptus, Casurina, lawn and cut flowers
15. Identification of Pests of stored grains, dry fruits, nuts, mushroom and green house crops.
16. Identification of Non insect pests – Mites, Nematodes, Rodents.
17. **Practical examination**

### **REFERENCE BOOKS**

1. Atwal, A.S. and G.S. Dhaliwal. 2003. Agricultural Pests of South Asia and Their Management. Kalyani Publishers, Ludhiana. 487 p.
2. Nair, M.R.G.K. 1986. Insects and Mites of Crops in India. Indian council of Agricultural Research, New Delhi. 295p.
3. Hill, D.S. 1985. Agricultural Pests of Tropics and their Control, Cambridge University Press, London. 653p.

4. Gupta, H.C.L., O.P. Ameta and V.K. Chechani. 2005. Management of Insect Pests of Horticultural Crops. Agrotech Publishing Academy, Udaipur. 224p.
6. Regupathy, A. S. Palanisamy, N. Chandramohan and K. Gunathilagaraj. 2008. Guide on Crop Pests. Sooriya Desktop Publishers, Coimbatore. 264p.

## **PAT 324: DISEASES OF HORTICULTURAL CROPS AND MUSHROOM CULTIVATION (2+1)**

### **OBJECTIVES**

The subject covers the etiology, symptoms, mode of spread, survival and integrated management of important diseases due to fungi, bacteria, viruses, phytoplasma, phanerogamic parasites and non-parasitic causes of the horticultural crops and also cultivation of edible mushrooms.

### **THEORY**

#### **Unit I: Fruit crops**

Mango, Banana, Citrus, Grapes, Guava, Sapota, Pomegranate, Annona, Papaya, Jack, Pineapple, Ber, Aonla, Apple, Pear, Peach, Plum.

#### **Unit II: Vegetable crops**

Brinjal, Tomato, Bhenidi, Cucurbits, Crucifers, Beans, Peas, Potato, Sweet Potato, Beet Root, Raddish, Yam, Colacasia and Cassava.

#### **Unit III: Spices and condiments**

Onion, Garlic, Chillies, Cardamom, Pepper, Betel Vine, Turmeric, Ginger, Fenugreek, Coriander, Clove, Nutmeg and Cinnamon

#### **Unit IV: Plantation crops, flower crops, medicinal plants**

Tea, Coffee, Cocoa, Rubber, Coconut, Arecanut, Vanilla. Jasmine, Rose, Crossandra, Chrysanthemum, Tuberose, Carnation, Lillium, Marigold. Gloriosa, Stevia, Coleus and Aloe.

#### **Unit V: Mushroom cultivation and post harvest diseases**

Importance of Mushroom – Cultivation of *Pleurotus*, *Calocybe*, *Agaricus* and *Volvariella* – Post harvest diseases of fruits and vegetables

### **PRACTICAL**

Study of symptoms and host parasite relationship of the following crops : mango banana, Citrus, Grapes Guava, sapota, pomegranate, annona, jack, papaya, pineapple, ber aonla, apple, pear, plum, peach tomato brinjal, bhendi, cucurbits crucifers, bean, peas, potato, cassava, sweet potato, yam, colacasia, onion, garlic, chillies, pepper, betel vine, turmeric, ginger, cardamom, fenugreek, coriander, clove, nutmeg, cinnamon tea, coffee, rubber, coconut, arecanut, vanilla, rose, jasmine, crossandra, chrysanthemum, tuberose, marigold, lillium and carnation. Post harvest diseases of fruits and vegetables -Mushroom cultivation : *Pleurotus* and *Calocybe* -Field visits

### **THEORY SCHEDULE**

Etiology, symptoms, mode of spread, survival, epidemiology and management of diseases of the following crops:

1. Mango
2. Banana
3. Citrus and grapes
4. Guava, sapota, pomegranate, annona and jack.
5. Papaya, pineapple, ber and aonla.
6. Apple, pear, plum and peach.
7. Post harvest diseases – Apple, mango, banana, citrus, grapes, papaya
8. Brinjal and bhendi
9. Tomato
10. Cucurbits
11. Cabbage, cauliflower, radish and beetroot
12. Potato, sweet potato, and cassava
13. Yam, colacasia, bean and peas
14. Onion and garlic.
15. Post harvest diseases – Tomato, potato
16. Chillies, carrot and onion
17. Mid Semester Examinations
18. Pepper and betelvine
19. Fenugreek, cinnamon, nutmeg, clove and coriander
20. Turmeric and ginger.
21. Tea

22. Coffee.
23. Coconut and Areca nut
24. Rubber
25. Cocoa , vanilla and cardamom
26. Jasmine and rose.
27. Crossandra and chrysanthemum.
28. Marigold, carnation, liliium and tuberose
29. Medicinal plants – *Gloriosa*, *Stevia*,
30. *Coleus* and *Aloe*
31. Mushroom cultivation : *Agaricus*
32. Mushroom cultivation : *Pleurotus* and *Calocybe*
33. Mushroom cultivation : *Volvariella*
34. Biotic and abiotic stresses of mushroom

## **PRACTICAL SCHEDULE**

### **Study of diseases symptoms and host parasite relationship of:**

1. Mango and banana.
2. Citrus and grapes.
3. Guava, sapota, pomegranate, annona, jack, papaya, pineapple, ber and aonla.
4. Apple, pear, plum, peach.
5. Tomato and brinjal.
6. Cucurbits and crucifers.
7. Bean, peas and potato.
8. Cassava, sweet potato, yam and colacasia.
9. Post harvest diseases of fruits and vegetables
10. Onion, garlic , chillies, pepper and betel vine
11. Turmeric, ginger, cardamom, fenugreek, coriander, Clove, Nutmeg, and Cinnamon
12. Tea, coffee and rubber.
13. Coconut, arecanut and vanilla.
14. Rose, jasmine, crossandra and chrysanthemum, Tuberose, Marigold, Lillium and Carnation
15. Mushroom cultivation : *Pleurotus* and *Calocybe*
16. Field visit
17. Final Practical Examinations

**Assignment:** Students should submit 50 well-preserved diseased specimens.

## **REFERENCES**

1. Arjunan.G. Karthikeyan, G, Dinakaran ,D. Raguchander,T. 1999 Diseases of Horticultural Crops, AE Publications, Coimbatore.
2. Pathak V.N. 1980. Diseases of Fruit Crops –. Oxford and IBH publishing Co.Pvt.Limited
3. Srikant Kulkarni and Yashoda R. Hegde, 2002, Diseases of Plantation Crops and Their Management. Udaipur, Agrotech, 176 p., ISBN 81-85680-58-2.
4. Singh, R.S. 1994. Diseases of Vegetable Crops –. Oxford & IBM Publishing Co.Pvt.Ltd.New Delhi
5. Bahl, N. 2000. Handbook of Mushrooms. Oxford & IBH Publishing Co., Pvt., Ltd., New Delhi.

## **AGM 325 ENVIRONMENTAL SCIENCE (1+1)**

### **OBJECTIVES**

The emphasis of the course will be on the biosphere resource, Sustainable agro ecosystem, pollution and environmental protection.

### **THEORY**

#### **Unit - I: Introduction to Ecology and Environment**

Introduction – Ecology – Environment : components, segments (hydrosphere, atmosphere, lithosphere and biosphere) – Ecosystem concepts – Species, Population, Community and Succession, Species interaction – Energy efficiencies and Energy flow – Food chain, Food web and Ecological pyramids, cropping pattern.

#### **Unit – II: Natural resources and Biodiversity**

Natural resources – Soil, Water, Air, Mineral, Energy, Forest resource; Biodiversity – importance, hot spots and conservation.

#### **Unit – III: Environmental Pollution**

Pollution: problems, types and sources – Soil, Water and Air pollution: Sources, effects and control measures – Noise pollution: Sources, effects and control measures – Radioactive, Heavy metal,

thermal and nuclear pollution – Global warming and climate change: Green House Gas (GHG) emission, Green House effect, impact on environment and agriculture – mitigation strategies.

#### **Unit – IV: Solid and Liquid waste management**

Types of wastes – Industrial wastes, Agricultural wastes, and Domestic wastes : Characteristics and Environmental impact – Solid waste management Techniques – Physical, Chemical and Biological methods. Standards for waste water disposal.

#### **Unit –V: Environmental protection**

Global treaties, conventions – National and State level organizations: Tamil Nadu Pollution Control Board (TNPCB), Central Pollution Control Board (CPCB) – Environmental Laws and Acts – Environmental Education – Clinic Development Mechanism (CDM) – Prevention of land degradation – Afforestation. Role of Information Technology on Environment.

#### **PRACTICAL**

Estimation of pollution indices of an agro-ecosystem – Diversity of flora and fauna in agricultural ecosystem – Laboratory safety and handling of chemicals and glass wares – Characterization of waste water and collection & sampling methods – Estimation of pH, EC and Total solids – Dissolved oxygen, Biochemical oxygen demand and Chemical oxygen demand – Acidity, Alkalinity, Hardness, Chlorides and Sulfates – Visit to common effluent treatment plant and degraded ecosystem – Assessment of water quality indicators (bio-indicators – coliforms) – Treatment of waste water: physical, chemical and biological methods – Monitoring Air pollution – Solid waste management – Composting of various solid wastes using microorganisms and vermicomposting – Heavy metals in contaminated soil and ecosystem.

#### **THEORY SCHEDULE**

1. Introduction to Ecology and Environment, Ecosystem concepts.
2. Species, population, community and succession, Species interactions.
3. Energy efficiencies and Energy flow – Food chain, food web and ecological pyramids.
4. Soil, water and mineral resources.
5. Forest and energy resources.
6. Biodiversity – importance, hot spots and conservation.
7. Pollution: Problems, types and sources – Soil pollution: Sources, effects and control measures.
8. Water pollution: Sources, effects and control measures.
9. Mid semester Examination.
10. Air pollution: Sources, effects and control measures.
11. Noise pollution: Sources, effects and control measures.
12. Global warming and climate changes: GHG emission, GH effect, impact on environment and agriculture – mitigation strategies.
13. Types of wastes – Industrial wastes, Agricultural wastes and Domestic wastes: Characteristics and Environmental impact.
14. Solid waste management techniques: Principles and practices.
15. Waste water treatment techniques – Physical, chemical and biological methods. Standards for waste water disposal.
16. Global treaties, conventions – National and State level organizations.
17. Environmental Laws and Acts – Environmental Education. Role of Information Technology on Environment.

#### **PRACTICAL SCHEDULE**

1. Laboratory safety and handling of chemicals and glass wares.
2. Estimation of population and its indices of species in an agro – ecosystem.
3. Diversity of flora and fauna in agricultural ecosystem.
4. Characterization of waste water: Collection and sampling methods.
5. Estimation of pH, EC and Total solids in waste water samples.
6. Estimation of Dissolved oxygen and Biochemical oxygen demand in waste water samples.
7. Estimation of Chemical oxygen demand in waste water samples.
8. Estimation of acidity, alkalinity and hardness in waste water samples.
9. Estimation of chlorides and sulfates in waste water samples.
10. Visit to common effluent treatment plant.
11. Visit to degraded ecosystem and Environmental impact assessment.
12. Assessment of water quality indicators (bio-indicators – coliforms).
13. Treatment of waste waters: Physical, chemical and biological methods.
14. Monitoring Air pollution and methods.
15. Solid waste management – Composting of various solid wastes using microorganisms and vermicomposting.
16. Estimation of Heavy metals in contaminated soil and water ecosystem.

## 17. Final practical Examination.

### REFERENCES

- 1) Balakrishnamoorthy. 2005. Environmental Management. Prentice – Hall of India Private Ltd. New Delhi.
- 2) Ramanathan N and Muthukkarupan SM. 2009. A Text book of Environmental Microbiology. Omsakthi Pathipagam, Annamalai Nagar.
- 3) Sharma P.D. 2006. Environmental Microbiology. Narosa Publishers, New Delhi.
- 4) Sharma, P.D. 2009. Ecology and Environment, Rastogi Publication, Meerat, India.
- 5) Stanley E. Manahan. 1997. Environmental sciences and Technology, Lewis publishers, New Delhi.
- 6) William P. Cunningham and Mary Ann Cunningham, 2007. Principles of Environmental sciences, Tata McGraw Hill Publishing Company, New Delhi.

### SAC 326 SOIL CHEMISTRY, SOIL FERTILITY AND NUTRIENT MANAGEMENT (2+1)

#### OBJECTIVES

To gain knowledge on plant nutrients and basic principles of soil fertility. This course will also impart knowledge on soil fertility evaluation, use of commercial fertilizers, importance of organic manures for sustainable agriculture. Further it aims to gain analytical knowledge on soil available nutrients.

#### THEORY

##### Unit -1

Nutrient elements- sources-Arnon's criteria of essentiality –essential, functional and beneficial elements- forms of nutrient in soil-nutrient availability and transport mechanism-nutrient deficiencies and toxicities- symptoms and management

##### Unit- 11

Nutrients – sources - transformation- fixation- losses- availability of nitrogen, phosphorus, potassium, calcium, magnesium and sulfur

##### Unit-111

Nutrients- sources- transformation-fixation-losses-availability of zinc, iron, manganese, copper, molybdenum and boron

Problem soils- definition- classification- acid soil, salt affected soil, calcareous soil- field diagnosis-characteristics –nutrient availability- reclamation measures- physical, chemical and biological methods

##### Unit- 1V

Soil fertility- definition- types- factors influencing soil fertility- concepts- soil fertility evaluation methods- visual, chemical and biological methods - soil productivity- definition- factors influencing soil productivity

Soil testing- definition- objectives- functions of STL- chemical methods employed in nutrient estimation in soil-Soil test based fertilizer recommendation- INM, IPNS, STCR, SSNM, RTNM

##### Unit- V

Fertilizer- definition- classification- sources- properties- reactions in soils of nitrogen, phosphorus and potassium fertilizers

Irrigation water- classification – water quality indices- quality appraisal- effect of poor water on soils and crops- management of poor quality waters

Nutrient use efficiencies (NUE) - definition- various NUE indices- NUE for macro and micronutrient fertilizers- factors influencing NUE- enhancement technique of NUE (soil, cultural and fertilizer strategy)

#### PRACTICAL

Soil nutrient analysis- available macro and micronutrients in soils- assessment of irrigation water- pH, EC, anions and cations- lime and gypsum requirement –plant analysis – N,P and K

#### THEORY SCHEDULE

1. Nutrient elements- essential nutrients- criteria of essentiality –beneficial and functional nutrients - functions, deficiency and toxicity symptoms
2. Ionic forms of plant nutrients in soil –Movement of ions from soil to roots – mass flow, diffusion, root interception and contact exchange
3. Nitrogen – occurrence, content and distribution – factors influencing the content of nitrogen in soil – forms of soil nitrogen – nitrogen cycle –
4. Transformations in soils - mineralization - aminization, ammonification and nitrification, immobilization
5. Transformation of nitrogen- losses – ammonia volatilization, nitrate leaching and denitrification and nitrogen fixation

6. Phosphorus – P-cycle – content in soils – forms of phosphorus in soil – inorganic and organic phosphorus compounds – phosphorus fixation – mechanisms of phosphate fixation
7. Factors affecting phosphate fixation in soil – methods to reduce phosphate fixation (organic matter additions, placement of P fertilizers etc.) – quantity and intensity
8. Potassium – content in soil – source – forms of soil potassium – potassium fixation
9. Factors affecting potassium fixation – quantity and intensity parameters – luxury consumption
10. Calcium – sources and content – forms of calcium in soil – factors affecting the availability of calcium
11. Magnesium – sources – content – forms of magnesium in soils – factors affecting availability of magnesium
12. Sulphur – S-cycle – occurrence – forms of sulphur in soil – sulphur transformation in soils – mineralization and immobilization
13. Zinc and iron – content – forms in soils – critical limits in soils and plants – factors affecting availability of zinc – functions
14. Copper and manganese – content – forms in soils – critical limits in soils and plants – factors affecting its availability
15. Boron and molybdenum – content – forms in soil – critical limits in soils and plants – factors affecting its availability
16. Problem soils – definition – classification – acid, saline soils – field diagnosis- characteristics – formation and nutrient availability in these soils
17. Saline sodic, sodic and calcareous soils – field diagnosis- characteristics – formation and nutrient availability in these soils
18. Mid Semester Examination
19. Reclamation measures of acid- lime requirement and saline soils
20. Reclamation measures of saline sodic, sodic- gypsum requirement and calcareous soil
21. Soil fertility and productivity- definition- types- factors influencing soil fertility and crop productivity
22. Concepts and approaches of soil fertility – Liebig’s Law , Mitcherlich law and Bray’s nutrient mobility concept
23. Soil fertility evaluation - approaches – nutrient deficiency symptoms – Plant analysis – rapid tissue tests – Diagnosis Recommendation Integrated System (DRIS) – indicator plants
24. Chemical methods of soil fertility evaluation- total and available nutrient analysis
25. Biological methods of soil fertility evaluation – microbiological methods – Sackett and Stewart techniques, Mehlich technique, Cunninghamella plaque method and Mulder’s *Aspergillus niger* test
26. Pot culture test – Mitscherlich’s pot culture method – Jenny’s pot culture test – Neubauer’s seedling method – sunflower pot culture technique for boron – A-value
27. Soil testing- definition- objectives- functions of STL- chemical methods employed in nutrient estimation in soil
28. Soil test based fertilizers recommendation – critical nutrient concept (Cate and Nelson) – critical levels of nutrients in soils – INM, STCR, IPNS, SSNM and RTNM
29. Fertilizer- definition- classification- sources- properties- reactions in soils of nitrogen, phosphorus and potassium fertilizers.
30. Irrigation water- classification -- quality appraisal
31. Water quality indices
32. Effect of poor water on soils and crops- management of poor quality waters
33. Nutrient use efficiencies (NUE) - definition- various NUE indices
34. Factors influencing NUE. Enhancement technique of NUE (soil, cultural and fertilizer strategy)

### **PRACTICAL SCHEDULE**

1. Soil nutrient analysis – Available N status in soil
2. Soil nutrient analysis – Available P status in soil
3. Soil nutrient analysis – Available K and
4. Soil nutrient analysis – Available S status in soil
5. Soil nutrient analysis – DTPA extractable micronutrients in soil
6. Estimation of organic carbon in soils
7. Assessment of quality of irrigation water (a) pH (b) EC
8. Estimation of carbonates, bicarbonates in irrigation water
9. Determination of calcium and magnesium in irrigation water by EDTA method
10. Estimation of K and Na and chlorides in irrigation water
11. Estimation of sulphate in irrigation water
12. Interpretation of irrigation water analysis data
13. Lime requirement of acid soil
14. Determination of gypsum requirement of alkali soil
15. Estimation of N in plant samples

16. Estimation of P and K in plant samples
17. Practical Examination

## REFERENCE BOOKS

1. John Havlin, James Beaten, Samuel Tisdale, Werner Nelson, 2005. Soil Fertility and Fertilizers - An Introduction to Nutrient Management. 7th Edition, Prentice Hall. Upper Saddle River, NJ.
2. Indian Society of Soil Science. 1998. Fundamentals of Soil Science. IARI, New Delhi.
3. Tandon, H.L.S. 1993. Methods of Analysis of Soils, Plants, Water and Fertilizers. Fertilizer Development and Consultation Organization, New Delhi.
4. Singh, Dhyan, Chhonkar, P. K. and Pandey, R. N. 1999. Soil Plant water analysis. A method manual. Indian agricultural research Institute, New Delhi, pp.160

## GPB 327 PRINCIPLES OF SEED TECHNOLOGY (2+1)

### OBJECTIVES

- To help the students to understand the basic principles of seed production.
- To teach the importance of seed testing, seed certification and seed policies which help the student to set up private seed production form in their own area.
- To create interest in seed business which in turn improves their economic status in future.

### THEORY

#### Unit I- Introduction to seed production

Seed- grain , seed production – grain production difference, classes of seeds- factors affecting seed production-deterioration of crop varieties-factors affecting deterioration and their control- production of nucleus and breeder seed- varietal release and notification

#### Unit II- Seed Production

Principles and methods of seed production. self and cross pollinated crops- Rice, maize, redgram, black gram, ground nut, sunflower, castor, cotton, tomato, brinjal, bhendi, onion and gourds

#### Unit III-Post harvest management

Seed drying, Seed processing - planning and layout of seed processing unit – equipments – air screen cleaner cum grader- grading-upgrading equipments - seed treatments -seed quality enhancement.

#### Unit IV-Seed Storage and Marketing

Seed packing-stages of storage-factors affecting seed longevity- general principles of seed storage – seed marketing- marketing structure and organization, factors affecting seed marketing-seed policies and demand-forecasting-planning.

#### Unit V-Seed Legislation

Seed certification – procedure for seed certification – Seed Act and Seed Rules – seed testing - Seed Control order 1983 – New Seed Bill 2004 – WTO – PBR – varietal identification- GOT – electrophoresis.

### PRACTICAL

Identification of seed and seed structure-seed quality analysis in Field and Horticultural crops-principles and procedures –seed sampling –physical purity analysis-germination analysis-moisture tests-viability test-seed health test- vigour tests – seed dormancy and breaking methods-seed quality enhancement-grow out test and electrophoresis for varietal identification-planting ratios, isolation distance, rouging etc. – visit to seed production plots-visit to seed processing plants – visit to seed testing laboratories- varietal identification in seed production plots.

### THEORY LECTURE SCHEDULE

- 1) Seed definition-characteristics of quality seeds –difference between seed-grain, seed production-grain production
- 2) Classes of seeds- generation system of seed multiplication
- 3) Factors affection of seed production-genetic and agronomic principles of seed production
- 4) Seed Deterioration- factors affecting deterioration and their control.
- 5) Maintenance of genetic purity. method of production of nucleus and breeder seed.
- 6) State and central varietal release methods and notification
- 7) Principles and methods of seed production in variety and hybrids
- 8) Seed production in cereals-rice, maize
- 9) Seed production in Pulses- redgram, black gram
- 10) Seed production in oilseeds- ground nut and sunflower
- 11) Seed production in castor and cotton
- 12) Seed production in vegetables- tomato, brinjal, bhendi.

- 13) Seed production in onion and gourds
- 14) Seed drying-forced air drying and heated air drying-moisture equilibrium between seed and air
- 15) Planning and layout of seed processing plant.
- 16) Seed processing equipment – Air screen cleaner cum grader and its working principles
- 17) Seed upgrading, various upgrading equipments and its uses.
- 18) Mid Semester examination
- 19) Seed treatments-types and methods
- 20) Seed packing-stages of storage-factors affecting seed longevity
- 21) General principles of seed storage.
- 22) Seed marketing- marketing structure and organization
- 23) Factors affecting seed marketing and seed policies
- 24) Seed demand and forecasting – seed planning
- 25) Seed Certification – Phases – Procedure.
- 26) Seed Act and Seed Rules
- 27) Central Seed Committee, Central Seed Certification Board, State Seed Certification Agency.
- 28) Central and State Seed Testing Laboratories
- 29) Establishing Seed Testing Laboratory – Seed testing procedures( purity, germination, moisture content, vigour test, testing for seed borne disease/ pest) for quality assessment.
- 30) Seed Law Enforcement – duties and powers of seed inspectors, offences and penalties.
- 31) Seed Control Order, 1983 and New Seed Bill, 2004
- 32) World Trading Organisation and Plant Breeders Rights
- 33) Varietal identification through grow out test
- 34) Varietal identification through electrophoresis

### **PRACTICAL SCHEDULE**

- 1) Identification of seed and seed structure
- 2) Seed quality analysis in field crops and horticultural crops-principles and procedure
- 3) Seed sampling and physical purity analysis
- 4) Germination testing and seedling evaluation
- 5) Moisture testing methods
- 6) Viability testing methods
- 7) Seed health testing
- 8) Seed vigour testing
- 9) Seed dormancy and dormancy breaking treatments
- 10) Seed quality enhancement treatments (egg flotation for rice, cotton delinting, procedure for pelleting, hardening, fortification and coating)
- 11) Grow out test and electrophoresis for varietal identification
- 12) Seed certification
- 13) Visit to seed production plots
- 14) Visit to seed processing plants
- 15) Visit to seed testing laboratories
- 16) Varietal identification in seed production plots
- 17) Final Practical Examination

### **REFERENCE:**

- 1) Agarwal. R. L. 1996. Seed Technology – Oxford and IBH publishing Co., New Delhi.
- 2) Agrawal P.K. (Ed.). 1993. Handbook of seed testing. Ministry of Agriculture, GOI, New Delhi
- 3) Bhaskaran, M., A. Bharathi, K. Vanagamudi, P. Natesan, N. Natarajan, R. Jerlin and K. Prabakar. 2003. “Principles of Seed Production and quality control” M/S. Kaiser graphics, Ganapathy, Coimbatore.
- 4) Bose, T.K., S.K. Mitra and N.K. Sathur. 1990. Propagation of tropical and sub-tropical Horticultural crops, Nayaprakash, Kolcutta.
- 5) Ramalingam, C., K. Sivasubramnaian and A. Vijayakumr. 1997. A guide to seed legislation. Rassi Computers, Madurai.
- 6) Singhal, N.C. 2003. Hybrid Seed Production in Field Crops. Kalyani Publishers, New Delhi.
- 7) Tunwar N.S. & Singh S.V. 1988. Indian Minimum Seed Certification Standards. Central Seed Certification Board, Ministry of Agriculture, New Delhi.

## **HOR 328: ORNAMENTAL AND LANDSCAPE GARDENING (1+1)**

### **OBJECTIVES**



This course provides the basic knowledge and state-of-the-art information on the ornamental and landscape gardening, which aims to develop a strong foundation for careers in the landscape industry to meet the needs of an ever changing world.

## **THEORY**

### **Unit I Ornamental Gardening**

Ornamental Gardening- Definitions, scope, importance and opportunities - History of gardening –India and Global context– Gardens in Timeline from the Ancient times (Egypt, Iraq, Greek, Roman and Percian gardens, Medieval Europe) to the Twentieth Century - Styles (or) Types of gardening - garden components.

### **Unit II Softscape elements in Garden**

Propagation methods, growth habit, foliage and flower features, pruning, training and growth regulation of softscape elements - Ornamental Trees, Shrubs, Creepers, Climbers, Annuals, Hedges, Edges, Topiary, Trophy, Carpet beds, Indoor plants and plants for special purposes- Cacti, Succulents and Rosarium – Turf management- Functional utility in garden, turf grasses, establishment and maintenance.

### **Unit III Hardscape elements in Garden**

Containers, soil, media - Different Hardscape elements in gardens and their position, materials required, establishment and maintenance - Planter boxes, Pavements, Decks, Garden Benches, Fountains, Cascades, Jacucci, Gazeboo, Statues, Birds bath, Fences, - water proofing techniques.

### **Unit IV Principles of Landscape Designing**

Principles and elements of landscape design- Concepts in landscape designing - symbols - Site analysis – Cliental preference – Bubble graph – Garden plan- Elevation diagram – Perspective diagram - layout of garden designs – Formal and informal gardens –Matching the plant materials to design criteria - Garden designing softwares and tools.

### **Unit V Special type of gardens**

Special type of gardens - water garden, Sunken garden, Marsh or bog garden and rock garden- Terrace garden, Paved garden, roof garden, Vertical garden, Meditation and Yoga garden- Landscape design for specific areas- planting avenues, schools, villages, beautifying railway stations, dam sites, hydroelectric stations, Traffic island, High way, Theme parks, Gated communities, river banks, planting material for play grounds - Contemporary gardens -Xeriscaping- Culture of bonsai - art of making bonsai.

## **PRACTICAL**

Identification and description of native and ornamental landscape plants - annuals, herbaceous perennials, climbers, creepers, foliage & flowering shrubs, trees, palms, ferns, ornamental grasses; cacti succulents - Matching the garden plants with design criteria - functional uses of plants in the landscape. Matching the garden plants with design criteria - functional uses of plants in the landscape - Site analysis - Planning and designing gardens – Bubble graph - layout of Garden plan –Designing of house garden, roadside planting, avenues for new High way, Theme parks, Gated communities, traffic islands- preparation of land for lawn and planting. Identification description and design of Hardscape elements - Planter boxes, Pavements, Decks, Garden Benches, Fountains, Cascades, Jacucci, Gazeboo, Statues, Birds bath, Fences - Special tools and implements used in landscape designing and execution -Visit to nearby gardens and nurseries - Use of softwares in garden designing – Calculation of Materials required and cost estimation for landscape plan.

## **THEORY SCHEDULE**

1. Ornamental Gardening- Definitions, scope, importance and opportunities
2. History of gardening – India and Global context – Gardens in Timeline from the Ancient times (Egypt, Iraq, Greek, Roman and Percian gardens, Medieval Europe) to the Twentieth Century
3. Styles (or) Types of gardening - garden components.
4. Propagation methods, growth habit, foliage and flower features, pruning, training and growth regulation of softscape elements - Ornamental Trees, Shrubs, Hedges, Edges.
5. Propagation methods, growth habit, foliage and flower features, pruning, training and growth regulation of softscape elements - Creepers, Climbers, Annuals, Topiary, Trophy, Carpet beds.
6. Propagation methods, growth habit, foliage and flower features, pruning, training and growth regulation of softscape elements -Indoor plants and plants for special purposes- Cacti, Succulents and Rosarium.
7. Turf management- Functional utility in garden, turf grasses, establishment and maintenance.
8. Containers, soil & media for planting of ornamental plants.
9. **Mid-semester**
10. Different Hardscape elements in gardens and their position, establishment, materials required and maintenance - Planter boxes, Pavements, Decks, Garden Benches and Fences.
11. Different Hardscape elements in gardens and their position, establishment, materials required and maintenance - Fountains, Cascades, Jacucci, Gazeboo, Statues and Birds bath and Water proofing techniques.
12. Principles and elements of landscape design and Concepts in landscape designing.

13. Site analysis and Cliental preference in landscape design planning Symbols in garden designing - Bubble graph.
14. Garden plan - Elevation diagram – Perspective diagram - layout of garden designs – Formal and informal gardens- Matching the plant materials to design criteria and Garden designing softwares and tools.
15. Special type of gardens - water garden, Sunken garden, Marsh or bog garden and rock garden- Terrace garden, Paved garden, roof garden, Vertical garden, Meditation and Yoga garden-
16. Landscape design for specific areas- planting avenues, schools, villages, beautifying railway stations, dam sites, hydroelectric stations, High way, Theme parks, Gated communities, river banks, planting material for play grounds.
17. Contemporary gardens -Xeriscaping- Culture of bonsai - art of making bonsai.

### **PRACTICAL SCHEDULE**

1. Special tools and implements used in landscape designing and execution.
2. Identification and description of native and ornamental landscape plants - annuals, herbaceous perennials, climbers, creepers, foliage & flowering shrubs.
3. Identification and description of native and ornamental landscape plants - trees, palms, ferns, ornamental grasses; cacti succulents
4. Matching the garden plants with design criteria.
5. Identifying functional uses of plants in the landscape design.
6. Landscape Site analysis.
7. Planning and designing gardens – Bubble graph - layout of Garden plan
8. Designing of house garden, roadside planting, avenues for new High way, Traffic islands, Theme parks, Gated communities,
9. Identification of Lawn grasses
10. Preparation of land for lawn and planting.
11. Identification description and design of Hardscape elements - Planter boxes, Pavements, Decks, Garden Benches.
12. Identification description and design of Hardscape elements - Fountains, Cascades, Jacucci, Gazeboo, Statues, Birds bath, Fences.
13. Visit to nearby gardens and nurseries –
14. Use of softwares in garden designing –
15. Calculation of Materials required for landscape plan.
16. Cost estimation of landscape plan.
17. **Practical Examination**

### **REFERENCE BOOKS**

1. Bose, T.K. and D. Mukherjee. 1977. Gardening in India. Oxford and IBH Publication Co., Kolkata.
2. Beard, J.B. 1973. Turfgrass: Science and culture. Agro Botanica. Jodhpur.
3. Chadha, K.L. 1986. Ornamental Horticulture in India. ICAR. Krishi Bhavan, New Delhi.
4. Gopalamy Iyyankar. 1970. Complete Gardening in Indian. Kalyan Printers, Bangalore.
5. Hari Krishna Pahiwal. 2009. Ornamental Gardening. National Book Trust, New Delhi, India.
6. Nambisan, K.M.P. 1992. Design Elements of Ladcape Gardening, Oxford and IBH Publications Co.(P) Ltd., Kolkatta.
7. Randhawa, G.S. 1973. Ornamental Horticulture in India. Today and Tomorrow's printers and publishers, New Delhi.

## **AEC 329 AGRICULTURAL FINANCE, BANKING AND CO-OPERATION (1+1)**

### **OBJECTIVES**

The objective of this course is to provide knowledge to the students about sources of agricultural finance, activities of bank and success models of cooperative sectors.

### **THEORY**

#### **Unit I Agricultural Finance – Nature and Scope**

Agricultural finance - importance – nature and scope - definition. Agricultural credit – meaning, definition, need, classification. Sources of credit – role of institutional and non-institutional agencies - advantages and disadvantages. Rural indebtedness. History and development of rural credit in India.

#### **Unit II Financial Institutions**

Institutional agencies – commercial banks - nationalization, AD Branches – area approach – priority sector lending, regional rural banks, lead bank, Kissan credit card (KCC) scheme, scale of finance. DIR Scheme – relief measures and loan waiver scheme. Higher financial institutions – RBI, NABARD, AFC, ADB, World Bank, Insurance and credit guarantee corporation of India. Rural credit policies. Microfinance - its role in poverty alleviation – Self-

Help Groups – Non-Governmental Organizations.

### **Unit III Co-operation**

Co-operation – philosophy and principles. History of Indian co-operative credit movement – pre and post independence periods. Co-operation in different plan periods. Co-operative credit institutions – structure - short term and long term credit - functions. Strength and weakness of co-operative credit system. Policies for revitalizing co-operative credit - salient features of Vaithyanathan Committee on revival of rural co-operative credit institutions. Reorganization of co-operative credit structure in Andhra Pradesh and single window system. Successful co-operative credit systems in Gujarat, Maharashtra, Punjab, etc. Special Co-operatives – LAMPS, FSS – objectives, role and functions.

### **Unit IV Banking and Insurance**

Negotiable instruments – meaning, importance, types. Central bank – functions. Credit control – objectives and methods – CRR, SLR, Repo Rate. Credit Rationing - dear money and cheap money. Non-Banking Financial Institutions (NBFI). Financial Inclusion- credit widening and credit deepening. Assessment of crop losses, determination of compensation. Crop insurance – schemes, coverage, advantages and limitations in application, estimation of crop yields. Livestock insurance schemes.

### **Unit V Farm Financial Analysis**

Principles of credit - 5C's, 3R's and 7 P's of credit. Repayment plans. Project management – feasibility – preparation - time value of money - compounding and discounting – concept of agricultural project proposal/appraisal of agricultural development projects - undiscounted and discounted measures. Evaluation of farm credit proposal. Farm financial statements – balance sheet, income statement, cash flow statement – financial ratio analysis.

### **PRACTICAL**

Visit to farm - estimation of credit needs, identification of problems and suggestions in the use of farm credit. Visit to a Primary agricultural co-operative credit society and DCCB to study their functions. Visit to a commercial bank branch to study its functions. Visit to lead bank to study the preparation and implementation of credit plans. Visit to NABARD to study its role and functions. Time value of money – compounding and discounting. Project preparation and appraisal - Undiscounted and discounted methods. Visit to SHGs. Study of crop insurance products. Banking procedure for availing loan. Repayment plans.

### **THEORY SCHEDULE**

1. Agricultural finance – definition, importance, nature and scope. Agricultural credit – definition, need, classification.
2. Source of credit – institutional and non- institutional agencies – types, roles, advantages and disadvantages. Rural indebtedness. History and development of rural credit in India.
3. Institutional agencies - commercial banks - nationalization of commercial banks – their role in rural credit. AD Branches – area approach. Priority sector lending, Regional rural banks.
4. Role and functions of lead bank – Preparation of district credit plan. Kisan credit card scheme. DIR scheme – relief measures and loan waiver scheme. Rural credit policies.
5. Higher financial institutions - RBI, NABARD, AFC, ADB, World Bank, Insurance and Credit Guarantee Corporation of India – Role and its functions in rural credit.
6. Microfinance – definition, role in poverty alleviation – Self-Help Groups – characteristics, role, functions, growth and development in India. Role of non- governmental organizations in promoting SHGs.
7. Co-operation – philosophy and principles – History of Indian co-operative credit movement – pre and post independence period. Co-operation in different plan periods.
8. Co-operative credit institutions – structure - short term and long term credit – its functions - Strength and weakness of co-operative credit system.
9. **Mid Semester Examination**
10. Policies for revitalizing co-operative credit - salient features of Vaidyanathan Committee on revival of rural co-operative credit institutions. Special co-operative institutions – LAMPS, FSS - objectives, role and functions.
11. Reorganization of co-operative credit structure in Andhra Pradesh and single window system. Successful co-operative credit systems in Gujarat, Maharashtra, Punjab, etc.
12. Negotiable instruments – meaning, importance, types - hundis, bills of exchange, promissory note, cheque and demand draft. Central bank – functions. Credit control – objectives and methods – CRR, SLR, Repo rate. Credit rationing - dear money and cheap money.
13. Non-banking financial institutions (NBFI). Financial inclusion - credit widening and credit deepening.
14. Assessment of crop losses, determination of compensation. Crop insurance – schemes, coverage, advantages and limitations in application, estimation of crop yields. Livestock

insurance schemes.

15. Principles of credit - 5C's, 3R's and 7 P's of credit. Project management – feasibility report preparation
16. Time value of money - compounding and discounting. Preparation and concept of agricultural project proposal/appraisal of agricultural development projects - undiscounted and discounted methods.
17. Evaluation of farm credit proposal. Farm financial statements – balance sheet, income statement and cash flow statement - financial ratio analysis.

### **PRACTICAL SCHEDULE**

1. Visit to a farm to study the credit needs, problems and suggestions in the use of farm credit.
2. Visit to primary agricultural co-operative Bank (PACB) to study its role, functions and procedures for availing loan
3. Visit to District central co-operative Bank (DCCB) to study its role, functions and procedures for availing loan – Fixation of Scale of Finance
4. Visit to Land development Bank to study long term credit.
5. Visit to a Commercial bank branch to study its role, functions and procedures for availing loan and lead bank to study the district credit plan, primary co operative bank for agricultural and rural development..
6. Visit to NABARD to study Potential Linked Credit Plan.
7. Project preparation and appraisal –undiscounted methods
8. Project preparation and appraisal –discounted methods
9. Evaluation of farm credit proposals
10. Exercise on preparation of repayment plans
11. Visit to Self-Help Group to study its characteristics, roles and functions
12. Analysis of different crop insurance products / visit to crop insurance implementing agency.
13. Visit to RRB to study its role, functions & procedures for availing loans.
14. Preparation of balance sheet and income statement
15. Preparation of cash flow statement
16. Financial ratio analysis
17. **Final Practical Examination**

### **REFERENCES**

1. Lee W.F. M.D. Boehlje, A.G. Nelson and W.G. Murray, (1998), Agricultural Finance, Kalyani Publishers, New Delhi.
2. Mammoria C.B. and R.D. Saxena 1973. Cooperation in India, Kitab Mahal, Allahabad.
3. Muniraj, R. 1987. Farm Finance for Development, Oxford & IBH, New Delhi.
4. Patnaik V.E. and A.K. Roy, (1988), Cooperation and Cooperative Management, Kalyani Publishers, Ludhiana
5. Subba Reddy, S. and P. Raghu Ram 2000. Agricultural Finance and Management, Oxford & IBH, New Delhi.

## **SEMESTER –VII**

### **RAE 411 CROP PRODUCTION**

#### **OBJECTIVES**

To gain knowledge about crop production technologies adopted in farmers field and to gain information of allied activities during the village stay programme.

#### **Crop Production Components**

- Study of cropping pattern, cropping systems, latest technologies in farm level, Production and productivity of different crops including Cereals, pulses, oil seeds, etc.,
- Study of soil type, fertility and soil related problems in relation to crop production.
- Study on irrigation practices followed.
- Identification of major crop varieties
- Identification of live stock breeds, common diseases, preventive measures to control diseases and there by ensuring knowledge on clean milk production.

### **RAE 412 CROP PROTECTION**

#### **OBJECTIVES**

To gain knowledge about crop protection practices including IPM and latest technologies at farm level during village stay programme.

### **Crop Production Components**

- Weeds: Identification and management practices
- Insects : Identification and management practices
- Diseases; Identification and management practices
- Knowledge on plant protection chemicals
- Integrated pest management practices for major field and horticultural crops.

### **RAE 413 RURAL AGRICULTURAL WORK EXPERIENCE (RAWWE) (0+4)**

#### **OBJECTIVES**

- To obtain first hand experience about village situation.
- To gain knowledge about cropping patten and adoption of latest technologies.
- To gain knowledge about preparation of individual farm plan

#### **STUDYING VILLAGE SCENARIO**

- Study of rural situation – village settlement pattern, demography, climate, land utilization pattern, resources inventory, infrastructural facilities, rural institutions, organizations, groups, customs, beliefs and value systems
- Study of cropping pattern, cropping systems, extent of adoption of latest technologies and constraints
- Studying the existing indigenous technical knowledge and its importance for technology generation.
- Knowing the communication pattern in villages
- Conducting need based skill demonstrations in the village

#### **STUDYING INDIVIDUAL FARM HOLDINGS**

- Contacting individual farmers to assess the differential farming system practiced by marginal, small, medium, big farmers and Farm Women
- Preparation of Individual farm plan

### **RAE 414 RURAL ECONOMICS – INDUSTRIAL ATTACHMENT**

#### **OBJECTIVES**

The objective of this course is to impart the experiential learning, skill development, hands on training and gain practical knowledge about various industries/ institutes to create self employment opportunities for farm graduates. The students will gain knowledge about Agri clinics, Rural Banks, Micro Financial Institutions (MFI) and Various Input Industries

#### **PROGRAMME**

The Department of Agricultural Economics will allot the student to various agro industrial units, / Agri Clinics,/ Agri Business Centers /NGO Organization / Agri related government institutions / Agricultural Finance Institutions / Input Industry

## **SEMESTER VIII**

### **MODULE I**

#### **CROP PRODUCTION**

### **MEL 421 DESIGN AND MANAGEMENT OF FARMING SYSTEMS (2+1)**

#### **OBJECTIVES**

Acquiring knowledge on ecological principles concepts of farming systems and cropping systems management and pathways towards sustainable coproduction of food and bioenergy. Getting focus on sustainable integrated farming systems from a systemic perspective. Understanding of principles for designing farming systems in adaptation to climate change targeting sustainable local food systems.

#### **THEORY**

##### **Unit - I: Cropping and farming systems management**

Cropping system – farming system – scope – importance – ecological principles – approaches and perspectives of farming system’s –Environmental conservation- practice in rural innovation –

methodologies – farming transitions – food networks for sustainable farming systems – bioenergy production

### **Unit - II: Assessment and formulation of farming system**

Modernization of agriculture and its relation to sustainability – Resource Management – Environmentally sustainable practices – Complexity and interaction between farming components – Policy making – location specific IFS models – organic recycling and IFS – Agrochemical residues – ill effects on non-target organisms.

### **Unit- III: Linking environment sustainability and farming**

Impact of Agro inputs – GMO's on farm productivity – environmental pollutants and farming – WTO and Agro industries. Natural resource management – crop production and animal production - practices principles and practices of LEISA techniques – livestock management in the changing climate - cold chain and rural management entrepreneurship and food sovereignty.

### **Unit – IV: Sustainable farming towards climate change**

Sustainable and climate resilient farming systems – challenges and development – prioritization – between produces and consumers – general challenges – to deal with globalization, climate change, biodiversity loss – conflicts over land and water – landscaping and designing – research – in adaptation to climate change – subsistent food production strategies – business options – food processing and value addition.

### **Unit- V: Livestock Component**

Basic management of Dairy Farm, Poultry Farm, Piggery Unit, Goat Farm, Duck Farm, Turkey Farm and Japanese Quail Farm - Prospects and constraints of integrating animal components in farm.

## **PRACTICALS**

Cropping system and farming system and it's importance-Hygienic milking procedures – dipping in goats – vaccination schedule for cattle and poultry-complementarity among farming components-value addition in farm produces.

## **THEORY LECTURE SCHEDULE**

1. Scope and importance of cropping system.
2. Ecological principles – approaches and perspectives of farming system's.
3. Practice in rural innovation – methodologies .
4. Farming transitions – food networks for sustainable farming systems.
5. Bioenergy production.
6. Modernization of agriculture and its relation to sustainability.
7. Resource Management.
8. Environmentally sustainable practices – Complexity and interaction between farming components.
9. Policy making – location specific IFS models.
10. Organic recycling and IFS – Agrochemical residues.
11. Ill effects on non-target organisms.
12. Impact of Agro inputs – GMO's on farm productivity.
13. Environmental pollutants and farming.
14. GMO and farming.
15. WTO and Agro industries.
16. Natural resource management.
17. Crop production and animal production practices- principles and practices of LEISA techniques.
- 18. Mid semester Examination**
19. Livestocks management in the changing climate.
20. Cold chain and rural management entrepreneurship and food sovereignty.
21. Sustainable farming systems for tomorrow Challenges and development – prioritization between produces and consumers.
22. General challenges to deal with globalization, climate change, biodiversity loss.
23. Conflicts over land and water.
24. Landscaping and designing.
25. Integrated modelling in farming systems research in adaptation to climate change.
26. Subsistent food production strategies.
27. Business options – food processing and value addition.
28. Fundamental management practices of dairy cattle farming.
29. Management of Poultry Farming.
30. Management practices of piggery.
31. Goat farming and its management
32. Duck farming and integrated farming systems.
33. Management of Turkey for meat production.
34. Japanese quail production.

## **PRACTICAL SCHEDULE**

1. Preparation of cropping schemes for different agro climatic zones.
2. Innovative methodologies in rural areas.
3. Linking farming systems with bio energy productions.
4. Environmental conservation through system approach.
5. Modernization of agriculture in farming systems.
6. Comparing farming situations for microbial consortia study.
7. Organic recycling in various farming situations.
8. Studying components of IFS and Introduction strategies in farming systems
9. Climatic normal for farming vs livestock
10. Modeling in farming systems management
11. Value chain through food processing in farming situations
12. Low input concepts for sustainable agriculture and resource management in farming systems.
13. Inter disciplinary approach in farming system
14. Hygienic milking procedures.
15. Dipping for goats.
16. Vaccination schedule for cattle and poultry.
17. **Final practical examination**

## **REFERENCES**

1. Devasenapathy, P., T. Ramesh and B. Gangwar 2007. Efficiency indices for agriculture management research. New India Publishing agency, Delhi.
2. Jayanthi, C. Devasenapathy, P and C. Vennila. 2007. Farming Systems. Principles and practices. Satish Serial Publishing House. Delhi.
3. Palaniappan, SP and K. Sivaraman. 2006. Cropping systems in the tropics Principles and management. New Age International (P) Ltd., New Delhi.
4. Panda, S.C., 2004. Cropping and Farming Systems. Agro bios Publishers. Jodhpur.

## **MEL 422 DRY FARMING AND WATERSHED MANAGEMENT(2+1)**

### **OBJECTIVES**

Understanding of different soil moisture conservation technologies for enhancing the agricultural productivity through holistic approach of watershed management and to study the principles of dry farming.

### **THEORY**

#### **Unit -I: Principles of dry farming**

Dry land farming and rainfed farming - Significance of dry farming in India- History of dry land agriculture- Distribution of Arid and semiarid regions in World, India and Tamil Nadu – Major crops of Dry land in India and Tamil Nadu - Characteristics - constraints

#### **Unit- II: Drought and moisture conservation**

Drought – Definition - Types and effects of Drought on crop production - Drought management - Contingent crop planning – Mid season correction – Mulching – anti-transpirants - Soil moisture conservation techniques and approaches - Water harvesting, storage and recycling - Integrated dry land technologies – Mechanization - Watershed management

#### **UNIT- III: Soil conservation**

Soil conservation: definition, methods of soil conservation; agronomic measures - contour cultivation, strip cropping, cover crops; vegetative barriers; improved dry farming practices; mechanical measures - bunding, gully control, bench terracing; role of grasses and pastures in soil conservation; wind breaks and shelter belts.

#### **UNIT- IV: Water shed development**

Watershed management: definition, objectives, concepts, approach, components, steps in implementation of watershed; development of cropping systems for watershed areas.

#### **UNIT- V: Drainage**

Drainage considerations and agronomic management; rehabilitation of abandoned *jhum*lands and measures to prevent soil erosion.

### **PRACTICAL**

Study of drought management technologies in dryland agriculture – Preparation of contingency crop plan for aberrant rainfall situations – Visit to watershed area to study the impact of various soil and moisture conservation methods. Field studies of different soil conservation measures. Run-off and soil loss measurements-Laying out run-off plot and deciding treatments-Identification of different grasses

and trees for soil conservation-Visit to a soil conservation research centre, demonstration and training centre.

### **THEORY LECTURE SCHEDULE**

1. Significance and scope of dryfarming in India and History of dryland agriculture.
2. Dry farming and rainfed farming- definition- aridity- drought .
3. Importance of drought on crop production.
4. Distribution of arid and semi-arid regions in World, India and Tamilnadu.
5. Dry farming regions – climatic characteristics.
6. Major crops of dryland in India and Tamilnadu.
7. Rainfall- intensity- distribution- rainfall use efficiency.
8. Characteristics of dryland farming and major constraints for crop production.
9. Choice of crops –cropping system- intercropping – sequential cropping.
10. Crop substitution - importance.
11. Soil moisture constraints and their management.
12. Drought: definition, types and effects of drought on crop production.
13. Drought management strategies and contingent crop planning.
14. Mid-season correction, mulching, anti transpirants, in-situ soil moisture conservation techniques and approaches.
15. Water harvesting, storage and recycling.
16. Integrated dryland technologies and farm mechanization.
17. Watershed: definition, principles, classification and management.
- 18. Mid-Term Examinations**
19. Soil conservation – Definition – soil conservation research in India.
20. Soil moisture constraints and their management.
21. Methods of soil and water conservation – In situ conservation.
22. Agronomic measures – contour cultivation - contour ploughing – summer ploughing - mulching – strip cropping – cover crops – Inter cropping.
23. Mechanical measures – Broad bed furrows – Dead furrow – contour bunding – compartmental bunding – Graded bunding –Terracing.
24. Biological measures – pastures – strip cropping with grasses – Ley farming – vegetative barriers.
25. Control of water losses – Evaporation control – shelter belts – wind breaks – Transpiration control – antitranspirants – Growth retardants – windbreaks – shelter belts.
26. Soil conservation programmes in rice valleys – national conservation strategy – Initiatives to control environmental pollution – new policy initiatives.
27. Watershed management micro and macro watershed – definition.
28. Principles of watershed management – need and advantages.
29. Concepts – Aim and approaches of watershed management – components of watershed management – water resource improvement – soil and moisture conservation in cultivated lands.
30. Components – soil water conservation and water harvesting – Hardware treatments – water ways – bunds - graded bunds – Terracing.
31. Water harvesting measures - minor irrigation tanks - Farm ponds – percolation tanks – stop dams.
32. Watershed development methods – crop management – selection of improved varieties – contingency plan – Integrated farming system.
33. Jhum/shifting cultivation – Jhum cultivation in India – basic concepts.
34. Harmful effects – ecological problems due to Jhum cultivation - Jhum cultivation in modern day – lay out of Jhum cultivation.

### **PRACTICAL SCHEDULE**

1. Mapping of Arid and semiarid region of World
2. Mapping of Arid and semiarid region of India
3. Rainfall analysis and crop planning
4. Study of dry land farming system
5. Preparation of cropping scheme for different dry farming situations
6. Demonstration of mulching and seed coating
7. Demonstration of spraying of anti transpirants and growth retardants
8. Acquiring skills in land shaping methods for in situ moisture conservation
9. Drought management technologies in dry land agriculture - Preparation of contingency crop plan for aberrant rainfall situations
10. Preparation and methodology for implementation of water shed projects
11. Preparation of model watershed programme
12. Identification of common tree species for wind breaks
13. Identification of common pasture grasses and legumes
14. Assessment of biomass production under watershed area



15. Visit to an Institute related to dry land agriculture
16. Visit to watersheds of NWDPPRA / CWDP – Input analysis

### **17. Final Practical Examination**

### **REFERENCES**

1. Arakeri HR & Roy D. 2004. Principles of Soil Conservation and Water Management. Oxford & IBH.
2. Dhruvanarayana VV. 2003. Soil and Water Conservation Research in India. ICAR.
3. Gurmel Singh, Venkataraman CG, Sastry B & Joshi P. 2003. Manual of Soil and Water Conservation Practices. Oxford & IBH.
4. Murthy VVN. 2005. Land and Water Management Engineering. Kalyani Publishers, New Delhi.

## **MEL 423 FOREST RESOURCE MANAGEMENT (2+1)**

### **OBJECTIVES**

A detailed studies on forests, silviculture, scientific forests management on forests utilization and forests management.

### **THEORY**

#### **Unit-I: Importance of forest and its classification**

Forest definition- Role of forests-Status of forests- global forest scenario- Status and classification of Indian forests - National forest policy— Forest management – concepts – forest menstruation - felling and conservation.

#### **Unit-II: Social Forestry**

Social Forestry- concept- Definition- Classification- Objectives- Joint Forest Management (JFM) – Agroforestry- Definition- concepts- Benefits- Constraints – Criteria for selection of tree species for Agroforestry- Silviculture – definition – principles and practices – classification – Benefits.

#### **Unit-III: Silviculture and its classification**

Silviculture – definition – principles and practices – classification – Benefits – models.

#### **Unit-IV: Forest Management and forest menstruation**

Forest management – concepts – forest menstruation - felling and conservation. Forest utilization – timber and Non-Timber Forest Produce (NTFP), Minor Forest Produce (MFP). Wood science and technology – wood expand seasoning and preservation.

#### **Unit-V: Forest Plantation and JFM**

Plantation forest management – clonal technologies – seed orchards.

### **PRACTICALS**

Nursery layout – Nursery technologies of important species – Clonal propagation – Volume estimation – Felling and transportation – Visit to forest plantation and forest depot – visit to saw mill – wood seasoning and preservation plant – visit to important forest based industries – Joint Forest Management.

### **THEORY LECTURE SCHEDULE**

1. Forest definition- Role of forests-Status of forests.
2. Global forest scenario- Status and classification of Indian forests.
3. National forest policy— Forest management – concepts.
4. Forest menstruation - felling and conservation.
5. Components of forests – forests classification based on – age – regeneration – composition management – ownership – growing stock.
6. Revised classification Indian forests types – moist tropical forests – tropical wet evergreen, semi evergreen and moist deciduous forests – littoral and swamp forest.
7. Dry tropical forests – tropical dry deciduous forest, thorn forests and dry evergreen forests
8. Montance sub tropical forests.
9. Montance temperate forests and Sub alpine – alpine shrub – forests types occurring in each state.
10. Social Forestry- concept- Definition
11. Classification- Objectives- Joint Forest Management (JFM).
12. Agroforestry- Definition- concepts- Benefits- Constraints.
13. Criteria for selection of tree species for Agroforestry.
14. Silviculture – definition – concepts and objectives and principles and practices – importance of silviculture.
15. Detailed silviculture including their distribution, economic value, phelology silviculture character, regeneration and management of broad leaved species Shorea robusta, Tectona grandis, Dalbergia sisoo, Acacias.

16. Detailed silviculture including their distribution, economic value, phelology silviculture character, regeneration and management of *Banbusa* spp, *Alibizzia* spp, *Bombex cieba*,
17. *B. malabaricum*.
18. Detailed silviculture including their distribution, economic value, phelology silviculture character, regeneration and management of *Eucalyptus* spp, *Casuarina* spp, *Prosopis juliflora*, *P. spicigera*.
- 19. Mid – Semester Examination**
20. Detailed silviculture including their distribution, economic value, phelology silviculture character, regeneration and management of *Azadirachita indica*, *Tamarindus indicus*, *Santalum album* and *Morus alba*.
21. Forest management definition – concepts, principles and practices for sustained forests yield and Forests menstruation – normal forests – kinds of abnormality – incumbent
22. Felling of trees – definitions – types – felling series in clear felling systems – felling series in regular shelter wood systems, irregular forests and coppice with standard system
23. Timber volume of normal growing stock – relation between increment and growing stock
24. Forest utilization – forest products – uses of forest products
25. Categorization of forest products – different non-timber produces – availability – collection and uses
26. Minor forest produce – availability – collection and uses – marketing
27. Wood science – definition – concepts – production, conception and trade in wood
28. Wood seasoning – principles and procedures – production capacity and raw material for wood based industry
29. Wood technology and techniques in wood based industry – Economics of investment and production
30. Forest plantations – objectives – functions – suitable species for raising forest plantations
31. Raising and maintaining forest plantation species – Cashew, *Eucalyptus* spp, *Acacia* spp, fuel wood spp – working out economics
32. Raising fuel wood plantations – raising high productivity pulp wood plantation working our economics
33. Propagation techniques – seed – vegetative propagation – clonal orchards
34. Identifying plus trees – marking – establishing seed orchards – seed collection – storage
35. Joint forest management – salient features – benefits – progress in JFM in various status

#### **PRACTICAL SCHEDULE**

1. Identification and description of seeds and seedlings of important silviculture tree species.
2. Identifying plus trees – characters – marking.
3. Collection of seed, seed purity – seed viability.
4. Seed treatment – seed germination percentage – seed rate calculation.
5. Nursery area selection – criteria for nursery – Nursery layout.
6. Nursery methods for important silviculture tree species – Mother bed – raised bed and sunken bed.
7. Raising tree saplings through seed.
8. Raising seedlings by vegetables method
9. Production of seedlings for woodlots – Avenue plantation.
10. Calculation of timber volume – using formulation
11. Visit to saw mill.
12. Felling of trees – timber classification – seasoning – sawing – preservation
13. Visit to forest plantation and forest timber depot.
14. Identifying and collection of minor forest produce & marketing.
15. Identification & collection of non -timber forest produce and marketing
16. Working out economics of important silviculture tree species.

#### **17. Final Practical Examination**

#### **REFERENCE BOOKS**

1. Khannan, L.S. 2000. Principles and practices of Silviculture. Khanna Bhandu,
2. Dehra Dun.
3. Lal, J.B. 2002. India's forest – Myth and Reality. Natraj Publishers. Dehra Dun. 304 p.
4. Ramaprakash. 2002. Forest Management. IBH publishers, Dehra Dun. 256 p.

### **MEL 424 INVASIVE ALIEN SPECIES AND BIO-DIVERSITY (1+1)**

#### **OBJECTIVES**

A basic understanding about the invasive alien species and the concepts of biodiversity conservation.

#### **THEORY**

##### **Unit-I: Importance of Invasive alien species**

Invasive alien species and GISP -definition- characteristics- losses caused by invasive weed species- Weed shift -WTO – SPS- agreement- Factors favouring invasiveness – Process of invasive traits of weeds- Threat to bio-diversity from IAS - Pest Risk Assessment- Prediction and prevention of IAS.

#### **Unit –II: Management of Invasive alien species**

Impact of agro inputs – biotechnology – GMO's and invasive alien species on farm productivity- Environmental pollutants abatement and farming – Restoration of degraded & wastelands – Safe guarding non-target organisms from inputs of crop protection.

#### **Unit-III: Biodiversity and its conservation**

Introduction – Definition: - genetic, species and ecosystem diversity - Value of biodiversity- consumptive use, productive use, social, ethical, aesthetic and - option values - Biodiversity at global, National and local levels- India as a mega-diversity nation – Hot-spots of biodiversity.

#### **Unit-IV: Bio-security**

Bio-security – invasive alien species and genetically modified organisms- Environmental impact and risk assessment- Threats to biodiversity - habitat loss, poaching of wildlife, man-wildlife conflicts- Conserving bio-diversity through organic agriculture: In-situ and Ex-situ conservation of biodiversity- Bioremediation.

#### **Unit-V: Bio refineries**

Bio - scavenging of eco-systems – aquatic environment and forestry – bio-remediation using GMOs – Bio polymers from transgenic plants. Bio informatics for crop improvement - Intellectual property Management– Product and Process patents– procedures– Legal implications.

### **PRACTICALS**

PRA – studying invasive alien species – bio-assay for herbicide residues – Mass propagation – selection of variants – Monitoring and evaluation of GM crops – Procedure for patent applications.

### **THEORY LECTURE SCHEDULE**

1. Invasive alien species –definition- characteristics.
2. Invasive alien species and GISP.
3. Losses caused by invasive weed species - Weed shift - WTO and SPS agreements.
4. Factors favouring invasiveness.
5. Process of invasive traits of weeds and threat to bio-diversity from IAS.
6. Pests risk assessment- prediction and prevention of IAS.
7. Impact of agro inputs – biotechnology – GMO's and invasive alien species on farm productivity.
8. Restoration of degraded & wastelands – Safe guarding non-target organisms from inputs of crop protection.
9. **Mid semester Examination**
10. Introduction – Definition - genetic, species and ecosystem diversity.
11. Value of biodiversity - consumptive use, productive use, social, ethical, aesthetic and - option values.
12. Biodiversity at global, National and local levels- India as a mega-diversity nation – Hot-spots of biodiversity.
13. Bio-security – invasive alien species and genetically modified organisms- Environmental impact and risk assessment- Threats to biodiversity - habitat loss, poaching of wildlife, man-wildlife conflicts.
14. Conserving bio-diversity through organic agriculture: In-situ and Ex-situ conservation of biodiversity. Bioremediation.
15. Bio - scavenging of eco-systems – aquatic environment and forestry – bio-remediation using GMOs.
16. Bio polymers from transgenic plants. Bio informatics for crop improvement –
17. Intellectual property Management – Product and Process patents – procedures – Legal implications.

### **PRACTICAL SCHEDULE**

1. Invasive alien weeds
2. Invasive alien pests
3. Threats from invasive alien species
4. Weed Risk Assessment
5. Awareness modules for IAS
6. Education programme modules for IAS
7. Bio-assay techniques for herbicide residues
8. Bio-assay techniques for organic residues
9. Protocol for GM crops and monitoring and evaluation of GM crops
10. Phyto sanitation for processed and export commodities
11. Evolving data and work sheet for product and process patents
12. Protocols and implications of patents
13. IPR issues

14. Bioremediation
15. Applications of ecology in agriculture.
16. Role of gene parks and banks

**17. Final Practical examinations**

**REFERENCES**

1. Chris Knight, Richard Stanely and Leighton Jones, 2003. Agriculture in the food supply chain- British Crop Protection Council, UK.
2. James E Horne and Mauro M.C.Dermott, 2001. The next green Revolution-Haworth press, USA.
3. Organic Agriculture, Environment and Food security, 2004. FAO Publication.
4. Palaniappan SP, 2004. Agricultural input and Environment- Scientific publishers.

**MEL 425 DAIRY AND POULTRY PRODUCTS TECHNOLOGY (1+1)**

**OBJECTIVES**

Raising knowledge on production practices of animal components of farming systems.

**THEORY**

**Unit – I - Milk Composition**

Milk – Composition of milk – Factors influencing composition of milk – Types of milk – Homogenization – Pasteurization of milk.

**Unit – II - Dairy Products – I**

Fat rich Dairy products – Preparation of Cream, Butter, Ghee – Preparation of Ice cream

**Unit – III - Dairy Products – II**

Indigenous milk products – Preparation of Khoa, Paneer, Channa – Dairy by products - Skim milk – Whey – Ghee residue.

**Unit – IV - Poultry Meat**

Slaughtering techniques of Poultry – Preparation of cut-up parts – Inspection and grading of poultry meat.

**Unit – V - Egg and Egg products**

Composition of egg – Grading of egg – Factors affecting egg quality – Preservation of egg – Value added egg products

**PRACTICALS**

Platform test for milk – determination of specific gravity, fat percentage, total solids and acidity in milk – adulterants in milk – demonstration of cream separation and ghee – preparation of ice cream and judging its quality – preparation of paneer, channa and flavored milk – dressing of poultry – cut-up parts of poultry meat – value added poultry meat products – candling and grading of eggs – preservation of eggs – preparation of value added egg products.

**THEORY LECTURE SCHEDULE**

1. Introduction to Dairy and Poultry Industry.
2. Definition and Composition of milk – factors influencing composition of milk
3. Types of milk.
4. Pasteurization.
5. Preparation of Cream.
6. Preparation of Butter and Ghee.
7. Preparation of Ice cream.
8. Preparation of Khoa, Paneer and Chann and Dairy by products – Skim milk – Whey – Ghee Residue.
9. **Mid semester examination**
10. Slaughtering techniques of poultry.
11. Preparation of cut up parts.
12. Inspection and grading of poultry meat.
13. Composition and nutritive value of egg.
14. Factors affecting egg quality.
15. Grading of eggs.
16. Preservation of egg.
17. Value added egg products.

**PRACTICAL SCHEDULE**

1. Platform test for milk.
2. Determination of Specific Gravity of milk.

3. Estimation of fat percentage and total solids in cow's milk.
4. Determination of acidity in milk.
5. Detection of adulterants in milk.
6. Demonstration of cream separation.
7. Preparation of Ghee.
8. Preparation of Ice cream and judging its quality.
9. Preparation of Khoa.
10. Preparation of Paneer and Channa.
11. Preparation of flavoured milk.
12. Dressing of Poultry.
13. Preparation of cut up parts of poultry meat.
14. Preparation of value added poultry meat products.
15. Candling and grading of eggs.
16. Preservation of eggs and value added egg products.
17. **Final Examination**

#### **REFERENCES:**

1. Carmen R. Parkhurst and George J. Mountney, 2002. Poultry Meat and Egg Production, CBS Publishers and Distributors, New Delhi – 2
2. Dairy India Year Book 2007. A-25, Periyadarshini Vihar, New Delhi.
3. Mead, G.C.2004.Poultry meat processing and quality.Woodhead Publishing Ltd., Cambridge, London.
4. Shai Barbut.2002.Poultry products processing: An industry guide.CRC Press, London.

## **MODULE II COMMERCIAL ENTOMOLOGY AND PATHOLOGY**

### **MEL 426 MASS MULTIPLICATION AND APPLICATION OF ENTOMOPHAGES AND ENTOMOPATHOGENS 2+1**

#### **OBJECTIVE:**

To know the mass production procedure of parasitoids, predators and pathogens and their application techniques

#### **THEORY**

##### **Unit I: History and Status of biological control**

Biological control – importance – history, Classical biological control. Examples of successful instances of exploitation of biological control in India. Role of biological control in IPM.

##### **Unit II: Predators**

Insect predators of agricultural and horticultural importance – biology – life cycle - predatory potential of important insect predator. Production techniques of Predators – *Cryptolaemus*, *Cyrtorhinus* and *Chrysopa*. Spiders – Important species - Predatory potential- Role of spiders in agro-ecosystems.

##### **Unit III: Parasitoids**

Insect parasitoids of agricultural and horticultural importance, types of parasitoids and parasitism, biology – life cycle - host selection behavior of important parasitoids. Mass production techniques of Trichogrammatids, Chalcids, Bethyids, Ichneumonids and Braconids

##### **Unit IV: Entomopathogens**

Entomopathogens of agricultural and horticultural importance. Symptomatology and host range of entomopathogenic bacteria, fungi, viruses, protozoa, rickettsiae, spiroplasma and entomophilic nematodes. Mass production of entomopathogens - virus, bacteria, fungi and entomophilic nematodes. microbial insecticides - Formulations techniques, quality control and registration procedures.

##### **Unit V: Application techniques**

Field application of entomophages and entomopathogens – formulation - doses – techniques of release/ application – field efficacy, conservation and augmentation – ecological manipulation - dirty field technique, compatibility of entomophages and entomopathogens and marketing issues.

#### **PRACTICAL**

Identification of important entomophages and entomopathogens. Mass production techniques of predators - *Cryptolaemus*, *Cyrtorhinus* and *Chrysopa*, parasitoids – Trichogrammatids, Chalcids, Bethyids, Ichneumonids and Braconids and entomopathogens - bacteria, fungi and virus. Insectary facilities and equipments required for mass multiplication. Diagnosis of insect diseases (fungal, bacterial

and viral). Identification of important spider groups. Bio assay to test the efficacy of entomophagous, entomopathogens and haemocytometer techniques to standardize the microbial load in a formulation.

**Assignment:** Each student has to submit a report on economics of mass multiplication of entomophages/entomopathogens.

### **THEORY LECTURE SCHEDULE**

1. Biological control – importance and history.
2. Classical biological control and its principles.
3. Status of biological control in India, Examples of successful instances of exploitation of biological control in India.
4. Role of biological control in IPM.
5. Insect predators of agricultural and horticultural importance.
6. Biology – life cycle - predatory potential of important groups of insect predators.
7. Mass production techniques of Green lace wings.
8. Mass production techniques of lady bird beetles.
9. Mass production techniques of mirid bugs.
10. Role of spiders in agro-ecosystems
11. Important species of spiders, its biology and predatory potential.
12. Insect parasitoids of agricultural and horticultural importance
13. Types of parasitoids and parasitism
14. Biology and life cycle of important groups of insect parasitoids and host selection behaviour.
15. Mass production techniques of *Trichogramma*.
16. Production techniques of Chalcids.
17. **Mid semester examination**
18. Production techniques of Bethylids.
19. Production techniques of Ichneumonids.
20. Production techniques of Braconids.
21. Entomopathogens of agricultural and horticultural importance.
22. Symptomatology and host range of entomopathogenic bacteria and fungi
23. Symptomatology and host range of entomopathogenic viruses, protozoa, rickettsiae and spiroplasma
24. Symptomatology and host range of entomophilic nematodes.
25. Mass production of NPV.
26. Mass production of entomopathogenic bacteria.
27. Mass production of entomopathogenic fungi.
28. Mass production of entomophilic nematodes.
29. Formulations techniques, of microbial insecticides
30. Quality control and registration procedures of microbial insecticides.
31. Field application of entomophagous
32. Techniques of release – field efficacy, Conservation and augmentation - dirty field technique
33. Compatibility of entomophagous and entomopathogens with other methods of IPM
34. Marketing issues of biocontrol agents

### **PRACTICAL SCHEDULE**

1. Identification of important parasitoids.
2. Identification of important predators.
3. Identification of important entomopathogens.
4. Mass production of *Cryptolaemus*.
5. Mass production of *Cyrtorhinus*.
6. Mass production of *Chrysopa*.
7. Mass production of Trichogrammatids.
8. Mass production of Bethylids/Scelionids/ Chalcids.
9. Mass production of white and green muscardine fungi.
10. Mass production of entomopathogenic bacteria
11. Mass production of NPV.
12. Identification of diseased cadavers of insects.
13. Diagnosis of insect diseases (fungal, bacterial and viral).
14. Identification of important spider groups.
15. Bio assay to test the efficacy of entomophagous and entomopathogens
16. Haemocytometer techniques to standardize the microbial load in a formulation.
17. **Practical examination.**

### **REFERENCE BOOKS**

1. Hajek, A. E. 2004. Natural Enemies An Introduction to Biological Control. Cambridge university press, Cambridge, England. 396 p.

2. Lenteren, J.C.V. 2003. Quality Control and Production of Biological Control Agents Theory and Testing Procedures. CAB International, Wallingford, UK, 340 p.
3. Ignacimuthu SS and S. Jayaraj. 2003. Biological Control of Insect Pests. Phoenix Publ., New Delhi.
4. Saxena, A.B. 2003. Biological Control of Insect Pests. Anmol Publ., New Delhi.451p.
5. Khetan, S. K. 2001. Microbial pest control. Marcel Dekker, Inc., New York. 321p.

## **MEL 427 BIOLOGICAL CONTROL OF PLANT DISEASES (2+1)**

### **OBJECTIVES**

To study the significance of biological agents and to study the method of isolation of the antagonistic organism and mechanisms of action involved in it. Also the subject covers the mass multiplication methods, bio-formulation development and delivery methods.

### **THEORY**

#### **Unit – I: Fungal bio control agents**

Biological control of plant diseases – significance of fungal biocontrol agents – mechanism of disease control by biocontrol agents. Methods of isolation of *Trichoderma* from soil

#### **Unit – II: Bacterial bio control agents**

Biological control of plant pathogens with plant growth promoting rhizobacteria (PGPR) – significance of PGPR in disease management – mechanism of disease control by PGPR.

#### **Unit – III: Mass multiplication of biocontrol agents**

Methods of isolation of *Trichoderma viride*, *Pseudomonas fluorescens*, *P. putida*, *Bacillus* spp. from soil, plant roots and seeds. Assessment and survival of bio control agents in plants and soil ecosystems – Mass production technology of bio control agents.

#### **Unit – IV: Formulations and delivery**

Selection of substrates for mass production – Bio-formulation development – methods of delivery system – quality parameter studies.

#### **Unit – V: Cost analysis and establishment of lab**

Fermentation systems – commercial aspects of mass production of PGPR – including establishing bio control agent laboratory.

### **PRACTICAL**

Isolation of biocontrol agents from soil and plants – preparation of selective media – isolation of bacterial and fungal antagonists by serial dilution techniques – maintenance of cultures – antibiotics and other metabolite production by PGPR and *Trichoderma* spp. Management of microbial contaminants – fermentation technology – development of formulaions – assessment of population in the formulations – packing materials and storage methods – visit to commercial biocontrol units.

### **THEORY LECTURE SCHEDULE**

1. Introduction to biological control of plant diseases
2. Significance of fungal bio -control agents
3. Mechanisms of disease control by the agents
4. Isolation methods of *Trichoderma* spp. from soil
5. Isolation methods of *Trichoderma* spp. from soil
6. Mass multiplication procedures
7. Mass multiplication procedures
8. Bio control by PGPR
9. Significance of PGPR
10. Mechanisms of disease control by PGPR
11. Mechanisms of disease control by PGPR
12. Methods of isolation of *Pseudomonas fluorescens*
13. Methods of isolation of *P.putida*
14. Methods of isolation of *Bacillus* spp
15. Assessment of survival of PGPR
16. Mass production technology of PGPR
17. Mid Semester Examinations
18. Mass production of PGPR
19. Selection of substrates for mass production
20. Selection of substrates for mass production
21. Bioformulation development
22. Bioformulation development
23. Methods of delivery system
24. Methods of delivery system
25. Quality parameter studies

26. Quality parameter studies
27. Fermentation systems
28. Fermentation systems
29. Commercial aspects of mass production of PGPR
30. Commercial aspects of mass production of PGPR
31. Establishment of PGPR lab
32. Establishment of PGPR lab
33. Plant diseases controlled by bio control agents
34. Plant diseases controlled by bio control agents

### **PRACTICAL SCHEDULE**

1. Introduction to bio control of plant diseases
2. Isolation of bio control agents from soil
3. Isolation of bio control agents from soil
4. Preparation of selective media
5. Isolation of bacterial antagonists
6. Isolation of bacterial antagonists
7. Isolation of fungal antagonists
8. Isolation of fungal antagonists
9. Maintenance of pure culture
10. Antibiotic production by PGPR
11. Antibiotic production by *Trichoderma* Spp
12. Management of microbial contaminants
13. Fermentation technology
14. Formulation development
15. Assessment of population in the formulations & Packing and storage methods
16. Visit to commercial bio control units
17. Final Practical Examinations

### **REFERENCE BOOKS**

1. Campbell. R. 1989. Biological Control of Microbial Plant Pathogens, Cambridge University Press, Cambridge.
2. Cook, R.J. and Baker, K.F. 1983. The Nature and Practice of Biological Control of Plant Pathogens, American Phytopathological Society, St. Paus, Minnesota, USA.
3. Hall, R.F. and Barry, J.W. 1995. Biorational Pest Control Agents-Formulations and Delivery. American Chemical Society, Washington, DC, USA.

## **MEL 428 MUSHROOM CULTIVATION (2+1)**

### **OBJECTIVES**

The subject cover various techniques involved in cultivation, maintenance, cropping pattern, harvest, pest and disease problems with their management and also nutritional value and preservation of edible mushrooms.

### **THEORY**

#### **UNIT-I: Importance of mushroom**

Mushroom science: Importance, related fields and their contribution global production-morphology and life cycle: *Pleurotus*, *Calocybe*, *Agaricus* and *Volvariella*, poisonous mushrooms and mushroom poisoning.

#### **UNIT – II: Techniques in mushroom breeding**

Genetics and breeding of cultivated mushrooms: homothallism and heterothallism, primary and secondary control systems, parasexuality, homokaryotic fruiting. Approaches to breeding: selection, mutation and hybridization – tissue culture, single and multispore isolates – biotechnological methods for strain improvement – laboratory techniques, equipments, culture media, sterilization, pure culture techniques – preservation of cultures. Spawn types – mother spawn and bed spawn.

#### **UNIT – III: Cultivation and Constraints**

Cultivation: oyster mushroom, milky mushroom, paddy straw mushroom, button mushroom and other edible mushrooms – outdoor cultivation – ecto-mycorrhizal mushrooms. Problems in cultivation: weed moulds, diseases, pests and abiotic disorders.

#### **UNIT – IV: Mushroom usage**

Uses of mushroom as food, nutritional and pharmaceutical values. Post-harvest technology: methods of preservation and value addition. Mushroom recipes: cooking methods, value added products, pickling, sauce, ketchup and chutney, instant food mixes, extruded and bakery products, quality and sensory evaluation.



## **UNIT – V: Cost analysis and project preparation**

Cost analysis and project preparation: principles of enterprise management, preparation of projects, project analysis and financial management – market survey, export procedures. Agricultural finance: sources of finance and acquisition.

### **PRACTICAL**

Introduction to mushroom – edible and poisonous type – edible mushrooms – *Pleurotus*, *Agaricus*, *Volvariella* and *Calocybe* - preparation of culture media – pure culture techniques – sterilizing techniques – media – glassware – maintenance of culture – mother spawn production – type of spawn – polybag method – multiplication of spawn mushroom cultivation techniques – maintenance of spawn running and cropping room – harvest – packing and storage of mushroom – problems in cultivation – pests, diseases and weed moulds – management – strategies – nutritional value – post-harvest technology – methods of preservation – other uses of mushroom – cost analysis and project preparation.

### **THEORYLECTURE SCHEDULE**

1. Introduction to Mushroom technology
2. Morphology and life cycle of *Pleurotus*
3. Morphology and life cycle of *Calocybe*
4. Morphology and life cycle of *Agaricus*
5. Morphology and life cycle of *Volvariella*
6. Poisonous mushrooms
7. Morphology and life cycle of genetics and breeding of cultivated mushrooms
8. Biotechnological methods for strain improvement
9. Laboratory techniques ,preservation of cultures
10. Spawn types, mother spawn and bed spawn
11. Cultivation of oyster mushroom
12. Cultivation of oyster mushroom
13. Cultivation of milky mushroom
14. Cultivation of paddy straw mushroom
15. Cultivation of paddy straw mushroom
16. Cultivation of button mushroom
17. Mid Semester Examinations
18. Outdoor visit
19. Ectomycorrhizal mushroom
20. Problems in cultivation :weeds, diseases, pests and abiotic disorders
21. Uses of mushroom as food [nutritional value]
22. Uses of mushrooms as medicine
23. Post harvest technology, method of preservation and value addition
24. Mushrooms recipes
25. Mushrooms recipes
26. Cost analysis in mushroom production
27. Project preparation
28. Project preparation
29. Principles of enterprise management
30. Market survey
31. Market survey
32. Export procedures
33. Agricultural finance: source of finance and acquisition
34. Agricultural finance: source of finance and acquisition

### **PRACTICAL SCHEDULE**

1. Introduction to mushrooms
2. Types of mushrooms
3. Preparation of culture media
4. Pure culture-maintenance of culture
5. Spawn and types of spawn
6. Poly bag method
7. Cultivation techniques
8. Cultivation techniques
9. Cultivation techniques
10. Cropping room
11. Harvest
12. Packing storage of mushroom

13. Problems in cultivation & its management
14. Nutritional value of mushroom
15. Post harvest technology & Other uses of mushroom
16. Cost analysis and project preparation
17. Final Practical Examinations

#### REFERENCE BOOKS

1. Aneja, K.R. 1996. Experiments in Microbiology, Plant Pathology, Tissue culture and Cultivation of Mushroom, Wishwa Prakasham, New Delhi.
2. Bahl, N. 2000, Handbook of Mushrooms. Oxford & IBH Publishing Co., Pvt., Ltd., New Delhi.
3. Chadha, K.L. and Sharma, S.R. 1995, Mushroom Bio-technology Advances in Horticulture. Volume 13, Malhotra Publishing House, New Delhi.

### MEL 429 INSECTS OF URBAN AND QUARANTINE IMPORTANCE 1+1

#### OBJECTIVE

To study the importance and management of urban and quarantine pests.

#### THEORY

##### Unit – I: Scenario of Public Health Pests

Public health pests – Rural, municipal and metropolitan cities, problems and challenges, agencies involved in public health pest management operations, global perspectives.

##### Unit – II: Major pests in human habitations

Mosquitoes – species - biology - breeding Sites. Mosquitoes as vectors – transmission of malaria, dengue fever, filariasis and chikungunya. House flies – species – biology and breeding sites- transmission of diseases. Cockroaches in food and Community Centres – species - biology and breeding sites. Rodents – species - biology and damages.

##### Unit – III: Minor pests in human habitations

Sand flies, bed bugs, human lice and fleas – breeding sites - outbreaks – disease vectoring and its impact. Termites – biology, breeding sites and problems to buildings and furniture. Birds menace in buildings. Bees, ants and wasp colonies and bats – their hardships. Dust mites - allergic problems.

##### Unit – IV: Quarantine entomology

Domestic and international quarantine. Quarantine restrictions in the movement of agricultural produce, case histories of exotic insect pests and their status. Acts related to import and export of agricultural produce and bio-control agents. Techniques to detect pest infestations. Techniques in elimination of contamination – fumigation, VHT and other safer techniques of disinfestation/salvaging of infected material. Phytosanitary certificate.

##### Unit – V: Urban Pest Management

Principles and methods of pest management in residential places and public buildings. Insecticides for domestic use and their safety. Rodent management in urban situations. Organic methods of domestic pest management.

#### PRACTICAL

Assessing pest status in dwellings (labs, canteen or hostel), implementation of pest control against flies, mosquitoes, bed bugs, cockroaches and rodents. Pre- and post-construction termite proofing methods, control of silverfishes in the library. Bird repellents. Removal of Bees, ants and wasp colonies and bats. Appliances for domestic pest control. Setting up of urban pest control centres. Techniques to detect pest infestations. Fumigants and their uses.

**Assignment:** Each student has to prepare and submit a report on problems of vector borne diseases/functioning of quarantine centres.

#### THEORY LECTURE SCHEDULE

1. Public health pests in rural, municipal and metropolitan cities and their problems and challenges.
2. Agencies involved in public health and pest management operations.
3. Mosquitoes – species - biology - breeding sites
4. Mosquitoes as vectors – transmission of malaria, dengue fever, filariasis and chikungunya.
5. House flies – species – biology and breeding sites.
6. Transmission of diseases by house flies.
7. Cockroaches– species - biology and breeding sites.
8. Rodents – species - biology and damages.
9. Mid semester examination
10. Sand flies, bed bugs, human lice and fleas – breeding sites - outbreaks – disease vectoring
11. Termites – biology, breeding sites and problems to buildings and furniture.

12. Bird menace in buildings, Bees, ants and wasp colonies and bats – their hardships and dust mites and their allergic problems.
13. Domestic and international quarantine, restrictions in the movement of agricultural produce.
14. Case histories of exotic insect pests and their status. Acts related to import and export of agricultural produce and bio-control agents.
15. Techniques to detect pest infestations quarantine centres. Techniques in elimination of contamination – fumigation, VHT and other safer techniques of disinfection/salvaging of infected material. Phytosanitary certificate.
16. Principles and methods of pest management in residential places and public buildings
17. Insecticides for domestic use and their safety. Methods of rodent management. Organic methods of urban pest management.

### **PRACTICAL SCHEDULE**

1. Assessing pest status in dwellings (labs/ canteen/ hostel).
2. Identification of species and assessing the population of mosquitoes.
3. Practicing of pest management against mosquitoes.
4. Practicing of pest management against housefly.
5. Practicing of pest management against bed bugs.
6. Practicing of pest management against cockroaches.
7. Practicing of pest management against rodents in urban situations.
8. Identification of castes of termites, its habitat and Practicing of pre- and post-construction termite proofing methods.
9. Practicing of pest management against silverfish in the library.
10. Acquainting bird and bat repellent methods.
11. Acquainting the method of removal of Bees, ants and wasp colonies.
12. Identification of appliances for domestic pest control.
13. Setting up of urban pest control centres.
14. Techniques to detect pest infestations in quarantine centres.
15. Identification of fumigants.
16. Practicing organic methods in urban situations.
17. **Practical examination.**

### **REFERENCE BOOKS**

1. Dhang, P. 2011. Urban Pest Management an Environmental Perspective. CAB. International, Wallingford, UK, 280 p.
2. Becker, N., Petric, D., Zgomba, M., Boase, C., Madon, M., Dahl, C. and Kaiser, A. 2010. Mosquitoes and Their Control. Springer, Heidelberg, Germany. 577 p.
3. Tyagi, B.K. 2010. The invincible deadly mosquitoes: India's health and economy enemy. # 1. Scientific Publishers, Jodhpur. 267 p.
4. Robinson, W. H. 2005. Urban Insects and Arachnids - A Handbook of Urban Entomology. Cambridge university press, Cambridge, England. 480p
5. Rajeev K and Mukherjee RC. 1996. Role of Plant Quarantine in IPM. Aditya Books, New delhi. 295p.

## **MEL 430 NATURAL PRODUCTS IN INSECT PEST MANAGEMENT AND THEIR FORMULATION TECHNIQUES 1+1**

### **OBJECTIVES**

To study the value of insecticides from plant and animal origin  
To know the formulation techniques of natural products

### **THEORY**

#### **Unit I: Scenario on Natural products**

Insecticides of plant and animal origin – importance – history - Vrکشayurveda. Global Scenario on utilization of Natural Products in IPM. Merits and demerits of natural products. Current Status of natural products in pest management.

#### **Unit II: Secondary plant compounds**

Secondary plant compounds – definition and occurrence- activity of secondary plant compounds. - Toxic amino acids, Proteinase inhibitors, Alkaloids, Cynogenic glycosides, Phenols, Tannins, Lignin, Flavonoids, Glucosinolates, Toxic lipids, Terpenoids, Saponins, Phytohaemagglutinins etc. Secondary plant compounds of important insecticidal plants.

#### **Unit III: Insecticides of plant and animal origin**

Plants of insecticidal value - Neem, Pungam, *Vitex*, *Acorus*, *Ocimum*, Garlic, Onion, Turmeric, *Adathoda* ect. Phytochemicals as Allelo-Chemicals, Natural Fumigants and Contact Insecticides against insect pests. Insecticides of animal origin, animal feces in pest management and Panchkavya.

#### **Unit IV: Mode of action of insecticides of Plant and animal Origin**

Antifeedant - Block sensory inputs from chemo receptors and mid gut enzymes and gustatory receptors. Interference in metabolism and moulting. Ovipositional deterrent, Repellent and Insect growth regulatory action. Neuromuscular blockage. Action on nerve membrane sodium channels, Generation of more action potentials, Cytotoxic effect, energy transfer - Oxidative phosphorylation and inhibit ATP and Proteins production.

#### **Unit V: Extraction methods and Formulation techniques of natural products**

Extraction of plant and animal products – Solvents based methods of extraction, Traditional methods of extraction - Arkam, Cold infusion, Asavam, Ksharam, Kashayam, Phaandam. Formulation techniques – shelf life – compatibility with biological control – synergistic effects – safety - commercially availability - registration protocols. Biotechnology a tool for Natural Product Synthesis. Natural products and Endogenous Development. Problems associated with natural products - Edaphic factors, Techniques of harvest, Extraction method, Shelf life, Bio mass, Socio-economic consideration.

#### **PRACTICAL**

Identification of plants of insecticidal value – Neem, Pungam, *Vitex*, *Acorus*, *Ocimum*, Garlic, Onion, Turmeric, *Adathoda* etc. Identification and collection of animal products. Preparation of plant products – various extraction procedures – Bioassays to study mode of action of natural products –field application – Impact on crop and storage pest control. Safety to non target organisms.

#### **THEORY LECTURE SCHEDULE**

1. Insecticides of plant and animal origin – importance – history - Vrکشayurveda.
2. Global Scenario on utilization of Natural Products in IPM.
3. Merits and demerits of natural products and Current Status of natural products in pest management.
4. Secondary plant compounds – definition and occurrence.
5. Activities of some plant compounds - Toxic amino acids, Proteinase inhibitors, Alkaloids, Cynogenic glycosides, Phenols, Tannins, Lignins, Flavonoids, Glucosinolates, Toxic lipids, Terpenoids, Saponins, Phytohaemagglutinins etc.
6. Secondary plant compounds of important insecticidal plants.
7. Plants of insecticidal value - Neem, Pungam, *Vitex*, *Acorus*, *Ocimum*, Garlic, Onion, Turmeric, *Adathoda* ect.
8. Natural Products as Allelo-Chemicals, contact insecticides and Fumigants in Pest Management
- 9. Mid semester examination**
10. Insecticides of animal origin and animal feces in pest management.
11. Modes of action – Antifeedant - Block sensory inputs from chemo receptors and mid gut enzymes. Effect on gustatory receptors, metabolism and moulting.
12. Ovipositional deterrent, Repellent, Insecticidal and Insect growth regulatory action. Insecticidal activity - Neuromuscular block, Nerve membrane sodium channels, Generation of more action potentials, Cytotoxic - Insect cell replication, energy transfer inhibition - Oxidative phosphorylation and inhibit ATP and Proteins production.
13. Solvent method of extraction of plant and animal products. Traditional method of extraction - Arkam, Cold infusion, Asavam, Ksharam, Kashayam, Phaandam, shoxlet.
14. Formulation techniques – shelf life – compatibility with biological control – synergistic effects – safety - commercially availability - registration protocols.
15. Biotechnology a tool for Natural Product Synthesis.
16. Natural products and Endogenous Development.
17. Problems associated with natural products - Edaphic factors, Techniques of harvest, Extraction method, Shelf life, Bio mass, Socio-economic consideration.

#### **PRACTICAL SCHEDULE**

1. Identification of plants of insecticidal value.
2. Sample collection procedures.
3. Preparation of plants for extraction.
4. Practicing shoxlet method of extraction.
5. Practicing solvent method of extraction at room temperature
6. Practicing water extraction method.
7. Practicing traditional methods of extraction.
8. Identification of animal products with insecticidal value
9. Basics of bio assay.
10. Bio- assay for anti-feedant
11. Bio- assay for Repellent study.

12. Bio- assay for insecticidal
13. Bio- assay for IGR study.
14. Calculation for desire concentration and field application.
15. Natural products in field and storage pest control
16. Safety studies to non target organisms.

**17. Practical examination**

**REFERENCE BOOKS**

1. Dubey N K, 2011. Natural Products in Plant Pest Management. CAB International, USA. 312 p.
2. Koul, O., G.W.Cuperus and N.Elliot. 2008. Areawide Pest Management - Theory and Implementation. CAB International. USA. 608 Pages
3. Dodia, D. A., I. S. Patel and G. M. Patel 2008. Botanical pesticides for pest management. Scientific Publishers, Jodhpur. 354 p.
4. Agnes M. Rimando, Stephen O. Duke. 2006. Natural Products for Pest Management. American Chemical Society, USA. 927p.
5. Dudani, A.T. 2003. Alternatives to Pesticides in Tropical Countries: Sustainable Agriculture - Food Security With Food Safety. Vigyan Prasar Publication. 360 p.

**MODULE – III  
NATURAL RESOURCE MANAGEMENT**

**MEL 431 REMOTE SENSING, GIS AND LAND USE PLANNING (2 +1)**

**OBJECTIVES:**

The Course aims to understand the methodological approaches in soil resource appraisal through modern tools of remote sensing techniques, concepts of Geographic Information System (GIS), Global Positioning System (GPS) and integration of GIS to prepare effective alternate land use plan based on resource database.

**THEORY**

**UNIT – I - Concepts of Land Use Planning**

Land use planning – Concepts and objectives – Methodological approaches – Information needed – collection techniques – Modern techniques for Land use planning – GIS and Land use planning – Watershed level planning – Regional level planning

**UNIT – II Remote Sensing Concepts**

Soil resource inventory– Conventional methods – Remote Sensing - principles and basic concepts – Characteristics of electromagnetic radiation – passive and active remote sensing - sensors and platforms – Use of satellite data in soil resource inventory. Satellite data acquisition – elements of image interpretation – satellite data products – digital image processing – land use mapping- interpretation and classification.

**UNIT – III– Geographic information system and its application**

Geographic information system– Components of GIS – GIS application in soil resource studies – Data integration – Generation of Thematic maps – Use of Remote Sensing and GIS in Land Use Planning – Decision support systems for land management – Remote Sensing and GIS softwares. Global Positioning System – principles and concepts – functions – applications in agriculture.

**UNIT – IV - Soil Information System and soil physical constraints**

Soil information system (SIS) – Concepts – Development of SIS in world, India – Application of SIS – Land Evaluation – Land capability – Classification - Land suitability – Fertility capability classification – Assessment of soil and land productivity potential - constraint Crop suitability – Soil quality – Soil and crop oriented water management – Soil and land irrigability and water management – Pedotransfer functions – Physical rating Index – Soil physical constraints – Management and recommendations.

**UNIT – V - Sustainable land management techniques**

Sustainable land management – Concept – Principles – Assessment and evaluation – Framework. Land degradation – Physical – Chemical – Biological – Extent – Cause – Management. Wastelands – Types of wastelands – Management of wastelands. Site specific nutrient management – Site specific crop management – Use of Decision support system – Models – QUEFTS – MANAGE – N – DSSAT – Prospects in Tamil Nadu, India

**PRACTICAL**

Morphological evaluation of soil – Soil map – Soil survey – Land evaluation – GIS – Thematic map preparation – Field visit – Soil fertility evaluation – Chemical analysis - Computation of soil and run off losses

## **THEORY LECTURE SCHEDULE**

1. Land use planning – Concepts and methodological approaches
2. Land use planning Techniques – Watershed level planning and regional level planning
3. Soil survey – importance – methods of soil survey
4. Types of soil survey – soil survey interpretation
5. Remote sensing – Concepts – Satellites and Sensors
6. Interaction of electromagnetic radiation
7. Remote sensing platforms and sensors
8. Satellite data acquisition- data products
9. Elements of image interpretation
10. Digital image processing
11. Remote sensing applications in agriculture
12. Soil mapping and Land use mapping
13. GIS – principles and components
14. Applications of GIS in agriculture
15. GPS- principles, concepts and functions
16. Use of GPS in agriculture
17. Soil information system – concepts and application
18. MID SEMESTER EXAMINATION
19. Land evaluation – land capability, land suitability
20. Fertility capability –
21. Land productivity
22. Soil quality
23. Pedo transfer functions
24. Sandy soil problems and management technologies, heavy clay soils – constraints and management technologies
25. Eroded soils – constraints and management technologies
26. Water logged and ill drained soils – constraints and management technologies
27. Sustainable land management – concept & principles, decision support system for land management
28. Land degradation – Extent – cause –Types
29. Management of degraded lands
30. Waste lands - types
31. Management of wastelands
32. Integrated soil fertility management - concepts
33. Site specific nutrient management-Site specific crop management
34. Use of decision support system models

## **PRACTICAL SCHEDULE**

1. Morphological evaluation of soils
2. Soil map and soil survey report preparation -I
3. Soil map and soil survey report preparation - II
4. Land capability classification
5. Land irrigability classification
6. Storie index rating
7. Fertility capability classification
8. Crop suitability classification
9. Satellite data products
10. Aerial photograph interpretation for soils
11. Visual interpretation of imageries for soils and land use
12. Digital image processing
13. Preparation of land use map
14. Thematic map preparation using GIS
15. Computation of soil and run off losses
16. Field visit to waste lands and land-use appraisal
17. Practical Examination

## **REFERENCES**

1. Anji Reddy, M. 2001. An introduction to Remote sensing and Geographical Information Systems” B.S.Publications, Hyderabad.
2. Barrough, P.A.1989. Principles of Geographical information Systems for land Resources Assessment. Oxford Univeristy, Clarendon Press, London
3. Dipak Sarkar, 2003. Fundamentals and Applications of Pedology. Kalyani Publishers, Ludhiana

4. Lillesand, M and Ralph W.Kiefer. 1994. Remote Sensing and Image interpretation (3<sup>rd</sup> Ed.) John Wiley and Sons, New York. Thomas
5. Roy, A.K and Varma, S.K. 2001. Waste Land Management and Environmental, Scientific Publishers, Jodhpur.

## **MEL 432 IMPACT ASSESSMENT OF AGROCHEMICALS IN ECO SYSTEM (2+1)**

### **OBJECTIVES**

This course aims to know the Chemistry, production techniques formulations, compatibility of Agro chemicals, impact assessment of agrochemicals on different ecosystems and human health. It also provides skills on preparation and use of indigenous pesticides for pest control and information on registration and quality control of agrochemicals.

### **THEORY**

#### **Unit – I - Chemistry of insecticides and fungicides**

Agrochemicals – Definition- Synonyms and historical background – Usage in India – Chemistry and production techniques of insecticides and fungicides.

#### **Unit – II - Chemistry of herbicides**

Chemistry and production techniques of herbicides and other agrochemicals registered in India – Chemistry of formulations – Compatibility of different Agrochemicals – Significance.

#### **Unit – III - Fate of agrochemicals in soil, plant and environment**

Methodology for conducting bioefficacy studies – Toxicology studies – Assessment of residues in soil, water and plant – Impact assessment of agrochemicals in different Ecosystems- Techniques in residue Analysis.

#### **Unit – IV - Safe use of pesticides**

Acceptable daily intake (ADI) and Maximum (Permissible) residue limit (MRL) – Occupational exposure of agrochemicals – Safety precautions in handling and storage – Contamination and disposal of agrochemicals- Functioning of multinational companies.

#### **Unit –V - Traditional preparations in pest control and insecticide act**

Plant extracts for ecofriendly pest control – Allelopathy and weed control Insecticides act – Registration requirements of different Agrochemicals- Quality control of agrochemicals.

### **PRACTICAL**

Analysis of pesticides – Physical tests – Acidity / alkalinity – Estimation of active ingredients in agrochemicals – Extraction and clean up procedures for determining residues from soil, water and plant samples – Determination of residues through bioassay and instrumentation techniques – visit to pesticide formation unit and pesticide testing laboratory.

### **LECTURE SCHEDULE**

1. Agrochemicals definition, synonyms, historical background and usage in India
2. Chemistry and production techniques of OP compounds
3. Chemistry and production techniques of carbamates
4. Chemistry and production techniques of synthetic pyrethroids
5. Chemistry and production techniques of novel insecticides and house hold pesticides
6. Chemistry and production techniques of preventive and eradicant fungicides available in market only
7. Chemistry and production techniques of systemic fungicides (only new classes)
8. Chemistry and production techniques of systemic fungicides continued
9. Chemistry and production techniques of herbicides (only registered products and new classes.
10. Chemistry of Agrochemical formulations
11. Agrochemical combinations and their significance
12. Compatibility of different agrochemicals
13. Material required and preparation techniques for agrochemicals
14. Methodology for evaluation of bioefficacy of agrochemicals
15. Toxicological properties of agrochemicals
16. Assessment of residues in soil and water and plant
17. Fate of agrochemicals in soil and water
18. MID SEMESTER EXAMINATIONS
19. Fate and metabolism of agrochemicals in plant
20. Impact assessment of agrochemicals in environment
21. Bio assay techniques for residue determination
22. Instrumentation techniques for residue determination
23. Recent advances in residue determination
24. ADI and MRL of agrochemicals

25. Evaluation procedures for occupational exposure of agrochemicals
26. Safety precautions in handling and storage of agrochemicals
27. Contamination and disposal of agrochemical
28. Functioning of multinational companies
29. Chemistry of plant extracts
30. Allelopathy and weed control
31. Insecticides act and its applications
32. Registration requirements of different agrochemical formulations
33. Quality control of agrochemicals
34. Good laboratory practices

### **PRACATICAL SCHEDULE**

1. Formulation analysis – Physical tests
2. Formulation analysis – Physical tests (contd...)
3. Estimation of acidity / alkalinity
4. Analysis of a.i. content of phosphamidan by titrimetry
5. Analysis of a.i. content of carbendazim by HPLC
6. Analysis of a.i. content of atrazine by GC
7. Principles of residue analysis of agrochemicals
8. Bioassay techniques to assay herbicide residues
9. Thin layer chromatography
10. Extraction and clean up of butachlor in soils
11. Extraction and clean up of mancozeb in plant
12. Determination of butachlor through GC
13. Determination of mancozeb through mancozeb in plant
14. Determination of paraquat residues in water
15. Visit to Pesticide formulation unit
16. Visit to Pesticide Testing Laboratory
17. Practical Examination

### **REFERENCES**

1. Cremlin, R.J. 1992. Agrochemicals – Preparation and mode of action. Wily publications, NewDelhi
2. Graniti et al., 1989. Phytotoxins and Plant pathogens. Springer Verlag, Berling
3. Jayakumar, R and Jagannathan,R .2003. Weed Science Principles, Kalyani Publishers, Ludhiana
4. O' brien and Yanamoto. 1983. Biochemical toxicology of insecticides, Academic Press inc. New York

## **MEL 433 SOIL, WATER, PLANT - HEALTH AND MANAGEMENT (2+1)**

### **OBJECTIVES**

The major objective of this course is to impart practical knowledge on soil related constraints, irrigation water quality appraisal guidelines & their efficient management, diagnosis of plant nutrient related problems, soil & water pollution and their impact on crop production and techniques for development of commercial fertilizer formulations & organic preparations.

### **THEORY**

#### **UNIT – I - Soil related constraints and their management**

Soil related constraints in crop production – Physical, Chemical and Biological constraints – Identification, extent, causes and measures to combat the constraints.

#### **UNIT – II - Irrigation water quality appraisal and its management**

Irrigation water – Ground water – Characteristics, problems due to use of poor quality water – water quality guidelines – Management of poor quality water.

#### **UNIT – III - Diagnostic Techniques for nutrient disorders**

Diagnosis of nutrient related problems in crop plants – Deficiency and Toxicity, Diagnostic key for identifying nutrient deficiency. Plant sampling for diagnosis of nutritional disorders – Tissue analysis and total analysis - Differentiating criteria for nutrient deficiency symptoms from insect and disease attack – Prescription – DRIS – Interpretation of plant analytical results.

#### **UNIT –IV Soil and water pollution**

Soil and water pollution – Impact on crop production. Management of polluted soils and water. Minespoils – Strategies for Rehabilitation of minespoils.



## **UNIT V - Commercial fertilizer formulations and organic preparations**

Techniques for the development of commercial fertilizer formulations – Organics – Preparations of enriched organic manures. Composting – Industrial, rural and urban wastes – Vermicompost – Biocompost. Humic acid formulation. Fertilizer mixtures – Macro, Micronutrient mixtures – Importance - Nutrient mixture for specific crops – for foliar spray – Indigenous materials

### **PRACTICALS**

Identification of physical and chemical constraints – Techniques for reclamation of acid, sodic and saline soils. Methods of fertilizer application for different crops. Assessing nutrient efficiency in problem soils. Analysis of irrigation water for its quality and interpretation. Diagnosis of crop plant for nutrient deficiency, toxicity and physiological disorders. Plant tissue tests. Analysis of polluted soils and waters. Preparation of composts, enriched organic manures. Formulation of micronutrient mixtures – Nutrient mixtures for foliar nutrition.

### **THEORY LECTURE SCHEDULE**

1. Soil constraints – extent and types
2. Physical constraints – Identification, types and causes
3. Management of soil physical constraints
4. Chemical constraints – Identification, Types, causes (Acid soil, salt affected soils)
5. Management of chemical constraints (Acid soils)
6. Management of chemical constraints (Salt affected soils)
7. Irrigation water resources – Groundwater potential and utilisation
8. Irrigation water characteristics and problems arising due to poor quality water
9. Water quality guidelines and their management
10. Diagnostic key for identifying nutrient deficiency and toxicity
11. Plant sampling for diagnosing nutrient disorders for field crops
12. Plant sampling for diagnosing nutrient disorders for Horticultural crops
13. Establishment of DRIS
14. Interpretation and reporting of results of plant analysis
15. Pollution, types & extent of pollution
16. Assessment of industrial chemical contamination in soil and water
17. MID SEMESTER EXAMINATION
18. Remediation of polluted soils
19. Mine spoils – Mining industries and their ill effects
20. Mine spoils – strategies for Rehabilitation
21. Recycling of organic manures – potential and prospects
22. Preparation of enriched organic manures – Enriched FYM, enriched micronutrients
23. Composting of agricultural and industrial wastes – Definition, principles – Types of composting
24. Composting of coirpith, pressmud and Biocompost
25. Composting of sugarcane trash, water hyacinth
26. Vermicompost Technology – Vermiwash, Vermicasting
27. Humic acid formulation (Extraction)
28. Effect of enriched organic manures and compost on soil and plant
29. Preparation of Fertilizer mixtures and their importance
30. Preparation of crop specific nutrient mixtures
31. Recent developments in plant nutrient formulations – Tablets - granules
32. Preparation of nutrient mixtures for foliar application
33. Preparation of indigenous nutrient mixtures - Panchakavya
34. Preparation of indigenous nutrient mixtures – Dasakavya

### **PRACTICAL SCHEDULE**

1. Key to identify physical constraints (Soil aggregate analysis, Shear strength)
2. Key to identify chemical constraints (EC, pH, ESP, SAR, CaCO<sub>3</sub>)
3. Techniques for Reclamation of Acid soil (Lime Requirement)
4. Techniques for Reclamation of Sodic soil (Gypsum requirement)
5. Techniques for Reclamation of Saline soil (leaching requirement)
6. Methods of fertilizer application ( for different crops & problems)
7. Assessing nutrient efficiency for enhanced productivity in problem soils
8. Interpretation of irrigation water quality (pH, EC, SAR, RSC, Potential salinity & Potential alkalinity hazards)
9. Diagnosis of plant nutrient deficiency and Toxicity symptoms
10. Diagnosis of physiological disorders in crop plants
11. Quick test / Tissue test for plant nutrient status and prescription.
12. Analysis of polluted soils & waters for heavy metals

13. Preparation of nutrient enriched organic manures
14. Preparation of different types of composts
15. Formulation of micronutrient mixtures
16. Preparation of nutrient mixtures for foliar spray (Panchakavya & Dasakavya)
17. Practical Examination

## REFERENCES

1. Indian Society of Soil Science 1991. Soil-related Constraints in Crop Production. Bulletin No.15. ISSS, New Delhi
2. Indian Society of Soil Science. 1996. Soil Management in Relation to Land Degradation and Environment, Bulletin No:17. ISSS. New Delhi
3. Palaniappan, S.P. and Annadurai, K. 1999. Organic Farming, Theory and Practice. Scientific Publishers (India), Jodhpur
4. Ranjan Kumar Basak. 2000. Soil Testing and Recommendation. Kalyani Publishers, New Delhi
5. Tandon, H.L.S. 1994. Fertilizers, Organic Manures, Recyclable wastes and Biofertilizers. Fertilizer Development and Consultation Organisation, New Delhi
6. Tandon, H.L.S. 1995. Recycling of crop, Animal, Human and Industrial wastes in Agriculture. Fertilizer Development and Consultation Organisation. New Delhi

## MEL 434 MICROBIAL AND ENVIRONMENTAL BIO-TECHNOLOGY (1+1)

### OBJECTIVES

The emphasis of the course will be on bioremediation of soil, bioenergy, biocomposting and microbial insecticides.

### THEORY

#### Unit - I: Bioremediation

Bioremediation of soil polluted with pesticides, fertilizers – Heavy metal pollution – Biotransformation – Hydrocarbon pollution – Super bug – Hydrocarbon extraction - Biomining of metals, Keratin degradation and Rhizoremediation.

#### Unit- II: Microbial food from wastes

Substrates for Single Cell Protein production – Agricultural wastes – Agro industrial wastes – Domestic wastes – Microorganisms used as Single cell protein – Yeasts, Algae, Molds and Bacteria – Nutritive value – Mass production of *Spirulina* – Uses.

#### Unit-III: Bioenergy

Renewable and Non – renewable energy. Bioethanol – Microorganisms involved in Bioethanol production – Raw materials for Bioethanol production – Strain improvement techniques – Uses of Bioethanol. Biogas production, Methanogenesis – Microbiology of methane formation in anaerobic digester. Feedstocks – animal wastes and alternative feed stocks, Types and operation of biogas plants – Applications of Biogas.

#### Unit-IV: Microbial Insecticides

Microbial agents for the control of pests and diseases, Target pest and suitable microbial insecticides, Mode of action of *Bacillus thuringiensis* and Nuclear Polyhedro Viruses, Advantages and limitations of microbial insecticides, Compatibility of microbial and chemical pesticides, Mass production of microbial insecticides. Fermentation - Formulation- Carrier material – Quality control.

#### Unit-V: Biocomposting

Waste Sources – Types of wastes – Characterization of wastes. Collection, handling and processing of wastes. Techniques in composting – Aerobic and Anaerobic composting – Vermicomposting – Windrow, Coir pith composting – Selection of microbial consortia for composting – Quality standards.

### PRACTICAL

Physical and chemical characterization of compost waste materials, Quantitative and Qualitative enumeration of microbes in waste materials, Estimation of CO<sub>2</sub> evolution from decomposition of organic wastes. Aerobic method of composting, Assessment of maturity of compost by physical and chemical methods, Vermiculture of recycling solid wastes. Alcohol production from sugarcane industrial wastes (Molasses), Production of biogas from Agricultural wastes, Production of biogas from alternate feed stocks, Production of Single cell protein using *Spirulina* sp. Estimation of BOD/COD in sugar mill effluent, Estimation of heavy metals in Tannery effluent. Field diagnosis of fungal diseases, viral diseases of insects and bacterial diseases of insects. Mass production of *Bacillus thuringiensis*.

### THEORY SCHEDULE

1. Bioremediation of pesticides, fertilizers and heavy metals.

2. Biotransformation – Hydrocarbon pollution and Hydrocarbon extraction.
3. Biomining of metals, Rhizoremediation and Keratin degradation.
4. Substrates for Single cell protein – Agro industrial, Agricultural and Domestic wastes.
5. Microorganisms uses as Single cell protein – Yeasts, Algae, Bacteria and Fungi.
6. Mass production of Single cell protein – Nutritive value and uses.
7. Bioethanol production.
8. Biogas production – Methanogenesis, Feedstocks – Types and operation of Biogas plant.
- 9. Mid semester Examination**
10. Microbial Insecticides – Target pests and Suitable insecticides, Mode of infection of BT and NPV.
11. Advantages and limitations of pesticides.
12. Mass production – fermentation, carrier materials – Quality control.
13. Formulation and application of pesticides.
14. Sources of wastes for composting – Physico-chemical properties – nutrient status.
15. Aerobic and anaerobic method of composting.
16. Vermicomposting – Windrow, coir pith composting.
17. Selection of microbial consortia for composting – Quality standards.

### **PRACTICAL SCHEDULE**

1. Physical and chemical characterization of compost waste materials.
2. Quantitative and Qualitative enumeration of microbes in waste materials.
3. Estimation of CO<sub>2</sub> evolution from decomposition of organic wastes.
4. Aerobic method of composting.
5. Assessment of maturity of compost by physical and chemical methods.
6. Vermiculture of recycling solid wastes.
7. Alcohol production from sugarcane industrial wastes (Molasses).
8. Production of biogas from Agricultural wastes.
9. Production of biogas from alternate feed stocks.
10. Production of Single cell protein using *Spirulina* sp.
11. Estimation of BOD/COD in sugar mill effluent.
12. Estimation of heavy metals in Tannery effluent.
13. Field diagnosis of fungal diseases of insects.
14. Field diagnosis of viral diseases of insects.
15. Field diagnosis of bacterial diseases of insects.
16. Mass production of *Bacillus thuringiensis*.

### **17. Final practical examination**

### **REFERENCE**

1. Asthana, D.K and Meera Asthana, 2007. A text book of Environmental studies, S. Chand & Company Ltd., New Delhi.
2. Dara, S.S. 1993. A text book of Environmental chemistry and pollution control. S. Chand and company Ltd, New Delhi.
3. Gabriel Bitton, 2005. Waste water Microbiology. John Wiley & sons. Inc., Publication, Florida.
4. Krishnan Kannan, 1991. Fundamentals of Environmental pollution, S. Chand and Co., Ltd., New Delhi.
5. Raina M Maier, Ian L. Pepper and Charles P. Gerba, 2006. Environmental Microbiology. Academic Press, California, USA.
6. Vijaya Ramesh, K. 2008. Environmental Microbiology, MJP Publishers, Chennai.

## **MEL 435 NATURAL RESOURCES ECONOMICS AND MANAGEMENT (1+1)**

### **OBJECTIVES**

To introduce the economics principles related to natural resource and environmental policy issues and to teach the economics of why environmental problems occur and alternative instruments of environmental policies.

### **THEORY**

#### **Unit- I Natural Resource Economics: Meaning**

Concepts, Classification and problems of natural resource economics – economy - environment interaction. The Material Balance principle, entropy law- resources scarcity - limits to growth - measuring and mitigating natural resource scarcity – Malthusian and Recardian scarcity – scarcity indices - resource scarcity and technical change.

#### **Unit II Resource management**

Theory of optimal extraction renewable resources – theory of optimal extraction exhaustible resources – economic models of forestry and fishery. Transaction costs – Coase's theorem and its critique - public goods – common property and open access resource management - collective action.

### **Unit III Agricultural Externalities**

Agricultural externalities – definition – evolution – regulation of externalities without direct intervention – policy tools – multidimensional problems of externality - environment valuation technique. Environment Impact Assessment – methods of valuation of natural resources.

### **Unit IV Types of Pollution**

Environmental pollution – Causes, effects and control measures of air, water, soil, marine, thermal and noise pollution. Nuclear hazards. Bio-safety and risk assessment. Rural and urban waste management. Global warming. Environmental act and related issues.

### **Unit V Government role**

Environmental Protection – role of government in resource management – environmental management – motivation and collective social action to plan and implement strategies for environmental management.

## **PRACTICAL**

Exhaustible resource management - resource inventory assessment techniques – visit to areas of resource degradation due to air, land and water pollution and assessment - willingness to pay concept and its quantification – assessment of environmental impact - Hedonic price method - Travel cost method – contingent valuation methods. Discount rate in natural resource management – social benefit cost analysis – the context and relevance of the Pollutor Pays Principle (PPP) and the User Pays Principle (UPP) – the relevance of the economic principle of optimality to environmental sustainability in agricultural resource use. - Visit to Pollution control board.

## **THEORY SCHEDULE**

1. Concepts, Classification and problems of natural resource economics
2. Economy - environment interaction, The Material balance principle, Entropy law
3. Resources scarcity limits to growth - measuring and mitigating natural resource scarcity
4. Malthusian and Recardian scarcity - scarcity indices – resource scarcity and technical change.
5. Theory of optimal extraction renewable resources - Theory of optimal extraction exhaustible resources
6. Economic models of forestry and fishery - transaction costs
7. Coase's theorem and its critique - public goods – common property and open access resource management –
8. Collective action. - agricultural externalities – definition – evolution
- 9. Mid –Semester examination**
10. Regulation of externalities without direct intervention - policy tools.
11. Multidimensional problems of externality -Environment valuation technique
12. Environment impact assessment -Methods of valuation of natural resources
13. Environmental pollution – causes
14. Nuclear hazards - bio-safety and risk assessment.
15. Rural and urban waste management - global warming - environmental act and related issues.
16. Role of government in resource management - Environmental management - motivation and collective social action to plan and
17. Implement strategies for environmental management.

## **PRACTICAL SCHEDULE**

1. Resource inventory assessment techniques
2. Visit to industries to study pollution abatement techniques.
3. Working out depletion rate of land and water
4. Working out depletion rate of fisheries and minerals
5. Visit to areas of resource degradation due to air, land and water pollution and assessment (Contd.,)
6. Visit to areas of resource degradation due to air, land and water pollution and assessment
7. Willingness to pay concept and its quantification
8. Assessment of environmental impact
9. Hedonic pricing analysis
10. Discussions on environment and poverty
11. Social benefit cost analysis
12. The context and relevance of the Pollutor Pays Principle (PPP)
13. User Pays Principle (UPP)
14. The economic principle of optimality to environmental sustainability in agricultural resource use.

15. Discounting techniques
16. Environmental planning
17. Role of pollution regulation agencies and strategies followed in India.

## REFERENCES

1. Ahmad Y, El Serafy S and Lutz E. (Eds.). 1989, Environmental Accounting for Sustainable Development. World Bank.
2. Hartwick JM and Olewiler N.D., 1998, *The Economics of Natural Resource Use*. 2<sup>nd</sup> Ed. Addison-Wesley Educational Publ.
3. Kerr J.M., Marothia D.K, Katar Singh, Ramasamy, C., and Bentley W.R. 1997, *Natural Resource Economics: Theory and Applications in India*. Oxford & IBH.
4. Kolstad C.D. 2000, *Environmental Economics*, Oxford University Press.
5. Tietenberg, T., 2003, *Environmental and Natural Resource Economics*. 6th Ed. Addison Wesley.

## MODULE - IV CROP IMPROVEMENT

### MEL 436 MOLECULAR PLANT BREEDING (2+1)

#### OBJECTIVES

- To teach the recent strids in molecular genetics
- To teach various gene transformation techniques

#### THEORY

##### Unit I: Classical Plant Breeding methods for crop improvement

Introduction – Selection – Hybridization and selection – Pedigree and bulk breeding – Heterosis breeding – mutation breeding – population improvement programme – synthetics and composites – release of new varieties.

##### Unit II: Molecular Genetics

DNA Sturcture – Types of DNA – central dogma of life – protein synthesis – DNA replication – gene regulation in prokaryotes – operon concepts – gene structure – Lac operon - fine genetic analysis – rII locus – DNA isolation, quantification and analysis – Genotyping – sequencing techniques.

##### Unit III: Genetic Markers Morphological (Phenotypic markers)

Biochemicals markers (Isozymes) and DNA based molecular markers – polymorphism – molecular basis of DNA markers – PCR-sequencing – primers – amplication of DNA by PCR – polyacrylamide gel electrophoresis – non PCR based markers (RFLP AND VNTR) – PCR based markers (RAPD, AFLP, STS, SSR, SNP etc) – ideal DNA markers – molecular markers advantages and disadvantages – application of markers in comparison with other markers.

##### Unit IV: Markers assisted selection

Genotype identification and genetic diversity – molecular marker based gene mapping and tagging of agronomically important traits – mapping populations (F<sub>2</sub>s, back crosses, RIL<sub>s</sub>, NIL<sub>s</sub> AND DH<sub>s</sub>) – STATISTICAL TOOLS in marker analysis – MAS of desirable genotypes for qualitative and quantitative traits – QTLs – QTL analysis for crop improvement – candidate genes – gene pyramiding – Genomic and genoinformatics for crop improvement – integrating functional genomics and proteomics information on agronomically important traits.

##### Unit V: Recombinant DNA Technology

Restriction endonucleases and restriction mapping – Transegenic plants – methods of transformation, selectable markers and clean transformation techniques – cloning vector – vector mediated gene transfer – physical methods of gene transfer-production of transgenic plants in various crops : cotton, wheat, maize, rice, soybean, oilseeds, sugarcane, brinjal, tomato etc – commercial releases- bio-safety issue of genetically modified plants (GMO<sub>s</sub>)

#### PRACTICAL

Genetic linkage mapping through classical plant breeding-Molecular laboratory and equipment needs-Preparation of reagents for plasmid DNA isolation-Extraction of genomic DNA and RNA- Isolation of plasmid DNA-Quantification of DNA-Restriction enzyme digestion of DNA-Preparation of competent cells and bacterial transformation  
RFLP-Agarose gel electrophoresis-DNA amplification using PCR and RAPD AFLP - SSR and SNP-QTL analysis -Gene transfer using particle bombardment (gene gun method)

#### THEORY LECTURE SCHEDULE

1. Introduction and selection of crops
2. Hybridization and selection

3. Heterosis breeding
4. Mutation breeding
5. Population improvement
6. DNA structure and types of DNA
7. Central dogma of life and DNA replication
8. Protein synthesis
9. Operon concept – Lac-operon
10. Fine genetic analysis – rII locus
11. DNA isolation and quantification
12. Gene sequencing
13. Morphological and biochemical markers\
14. Molecular markers and advantages
15. RFLP and VNTR markers
16. PCR based markers (RAPD, AFLP)
17. STS, SSR, SNP
- 18. Mid- Semester examination**
19. Marker assisted selection and crop improvement
20. Molecular genetic diversity
21. Gene mapping and tagging
22. Mapping population (F2, Backcross, RILs, NLS, DHs)
23. Statistical tools in molecular marker analysis
24. QTL
25. Gene pyramiding
26. Genomics and genoinformatics
27. Proteomics
28. Restriction enzymes
29. Restriction mapping
30. Gene transformation techniques
31. Vectors for plant gene transformation
32. Transgenic plants
33. GMOs
34. Bio-safety

#### **PRACTICAL SCHEDULE**

1. Genetic linkage mapping through classical plant breeding
2. Molecular laboratory and equipment needs
3. Preparation of reagents for plasmid DNA isolation
4. Extraction of genomic DNA and RNA
5. Isolation of plasmid DNA
6. Quantification of DNA
7. Restriction enzyme digestion of DNA
8. Preparation of competent cells and bacterial transformation
9. RFLP
10. Agarose gel electrophoresis
11. DNA amplification using PCR
12. DNA amplification using RAPD
13. AFLP
14. SSR
15. SNP
16. QTL analysis
17. Gene transfer using particle bombardment (gene gun method)

#### **REFERENCES**

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3. Malacinski, M. and D. Friefelder. 2003. Essentials of molecular biology. IV Ed. Jones and Bartlett publishers, Boston
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## MEL 437 PLANT TISSUE CULTURE (2+1)

### OBJECTIVES

- To teach various methods in invitro culture
- To teach commercial application of tissue culture techniques

### THEORY

#### Unit I

Introduction – Totipotency- History of tissue culture techniques – organization of tissue culture laboratory – culture room – culture vessels and their washing – different sterilization methods – tissue culture nutrient medium – Components and preparation – Selection of medium, Hormones : Auxins, cytokinins, GA, Abscisic acid, ethylene.

#### Unit II

Callus and cell suspension cultures – Callus induction – Subculture. Cloning – isolation of single cells – culture of single cells – cell viability test. Regeneration – shoot regeneration. Somatic embryogenesis concepts and application – synthetic seed technology - advantages.

#### Unit III

Anther culture – Culture medium – growth regulators – Stages of pollen development – Culture environment – Pretreatments – pollen culture – Ovary and ovule culture – Haploid production – Doubled haploids – Embryo culture – embryo rescue technique – endosperm culture.

#### Unit IV

Shoot meristem culture – Explant – Virus free plants and maintenance – culture medium – Browning of medium – Rooting of shoots – Transfer of plantlets to soil – somaclonal variation and its molecular basis – somaclonal variation and induced mutation – Resistant mutants – Application – achievements.

#### Unit V

Somatic hybridization – Protoplast isolation, culture and fusion – cybrids- in-vitro pollination methods – micropropagation and its commercial application (Banana and Rose) – advantages – cryopreservation methods – preculture - Freezing – Vitrification – Encapsulation dehydration.

### PRACTICAL

Tissue culture laboratory and equipment needs -Sterilization techniques-Preparation of culture medium-Cell suspension culture and callus induction-Somatic embryogenesis-Synthetic seeds-Anther and pollen culture-Ovary and ovule culture-Embryo rescue techniques -Embryo culture-Endosperm culture-Meristem culture-Protoplast culture and somatic hybridization -Micro propagation in banana-Cryopreservation of plant parts – visit to commercial tissue culture laboratory

### THEORY LECTURE SCHEDULE

1. Introduction and totipotency
2. History about plant tissue culture
3. Organization of tissue culture laboratory
4. Tissue culture laboratory equipments
5. Sterilization techniques and methods
6. Composition of tissue culture medium and preparation
7. Role of hormones in culture medium
8. Callus culture and callus induction
9. Isolation of single cell and cell suspension culture
10. Shoot regeneration techniques, concepts and application of somatic embryogenesis
11. Concepts and application of somatic embryogenesis
12. Synthetic seed technology and its advantage
13. Anther culture and its application
14. Pollen culture and its application
15. Ovary culture and its application
16. Ovule culture and its application
17. **Mid-Semester Examination**
18. Haploid production and doubled haploids and its significance
19. Embryo culture and its application
20. Embryo rescue techniques
21. Endosperm culture and its application
22. Meristem culture and rooting of shoots.
23. Maintenance and recovery of virus free stocks
24. Somaclonal variation and its molecular basis

25. Isolation of resistant mutants.
26. Somatic hybridization – Protoplast isolation and protoplast culture
27. Protoplast fusion (PEG) – Electrofusion technique
28. Selection of hybrid cells and regeneration
29. Cytoplasmic hybrids and applications of somatic hybridization
30. Invitro pollination methods
31. Micropropagation and its significance
32. Micropropagation in Banana and Rose
33. Production of secondary metabolites
34. Cryopreservation of plant parts.

### **PRACTICAL SCHEDULE**

1. Tissue culture laboratory and equipment needs.
2. Sterilization techniques
3. Preparation of culture medium
4. Cell suspension culture and callus induction
5. Somatic embryogenesis
6. Synthetic seeds
7. Anther and pollen culture
8. Ovary and ovule culture
9. Embryo rescue techniques
10. Embryo culture
11. Endosperm culture
12. Meristem culture
13. Protoplast culture and somatic hybridization
14. Micro propagation in banana
15. Cryopreservation of plant parts
16. visit to commercial tissue culture laboratory
17. **Final Practical examination.**

### **REFERENCES**

1. Bhojwani, S.S. and Razdan, M.K. 2006. Plant Tissue Culture Studies – Theory and Practice. Elsevier Publication.
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## **MEL 438 PLANT GENETIC RESOURCES (2 + 1)**

### **OBJECTIVES**

- To understand the origin and diversity of important crops and the importance of the conservation
- To understand on patent systems and international agreements on Agriculture
- To understand the classification of varieties using descriptors and utilizing germplasm in breeding programmes.

### **THEORY**

#### **Unit – 1 : Origin of species, and diversity conservation**

Plant Genetic Resources (PGR) and their importance - Agrobiodiversity and Centres of origin - Primary and secondary centres – Vavilov’s contribution to plant genetic resource conservation - PGR base for reconstruction and reconstellation of new cultivars - Exploration and collection: exploration missions - understanding the distribution, ecology, botany and genetic makeup of each crop species

#### **Unit – 2 : Collection of Germplasm and Conservation**

Collection- Patterns of variation and genetic makeup - sample size and collecting efficiency - Collection records: field and laboratory - Entering the collected material into the gene bank - Handling the site data - Conservation: ex situ conservation (long term and medium term repositories - merits and demerits of ex situ conservation - In situ conservation - conservation of wild relatives and land races - conservation in home gardens - community based plant conservation - botanical gardens and field gene



banks - seed saver programmes - National parks - Biosphere reserves - Relation of in situ conservation to nature conservation and agricultural production

### **Unit – 3 : Characterization and Documentation of Germplasm**

Documentation: initial data verification and reorganization - passport data - tasks of the documentation - requirements for documentation - existing data and data to be collected - data processing and information supply - Characterization: taxonomic - using plant descriptors - biochemical: using isozymes and DNA markers

### **Unit – 4 : Evaluation of Germplasm and Crop Genetic Network**

Evaluation: primary and secondary evaluations - Crop Genetic Resources network: International and National - Role of International Agricultural Research Centres (IARCs) in PGR conservation - National and Regional PGR centres - Intellectual Property Rights (IPR) and PGR - Plant Breeders rights – Farmers rights – PGR in strengthening Plant Breeding research system - Central data bases and their features - The core collection concept - PGR management - conventional and recent approaches - molecular markers in germplasm management - tracing the pedigree - identifying the duplicates - Utilization - types of collection

### **Unit – 5 : Patent Systems and Regulatory Bodies**

PGR exchange - national and international formalities - Plant quarantine check – Implications of World Trade Organisations (WTO), General Agreement on Trade and Tariff (GATT), Trade Related Intellectual Property Rights (TRIPs), Plant Variety Protection (PVP) and Convention on Biological Diversity (CBD) on PGR

## **PRACTICAL**

Methodologies for germplasm conservation - Exploration and collection: understanding the distribution, ecology, botany and genetic makeup of each crop species - Route map - Collection: sample size and collecting efficiency - Collection records: field and laboratory - Entering the collected material into the gene bank - Handling the site data - Conservation: ex situ conservation (long term and medium term repositories) - In situ conservation of germplasm: various approaches - Documentation: initial data verification and reorganization - passport data - requirements for documentation - data processing and information supply - Characterization: taxonomic - using plant descriptors - biochemical: using isozymes and DNA markers - Evaluation: primary and secondary evaluations - Crop Genetic Resources Network: International and National - Role of International Agricultural Research Centres (IARCs) in PGR conservation - National and Regional PGR centres visit - Intellectual Property Rights (IPR) and PGR - Plant Breeders - rights - Farmers rights - PGR in strengthening Plant Breeding research system - Central data bases and their features - The core collection concept - PGR management - conventional and recent approaches - molecular markers in germplasm management - tracing the pedigree - identifying the duplicates - Utilization - types of collection - PGR exchange - national and international formalities - Plant quarantine check.

## **LECTURE SCHEDULE**

1. Plant Genetic Resources (PGR) and their importance
2. Agrobiodiversity and Centres of origin
3. Primary and secondary centres – Vavilov’s contribution to plant genetic resource conservation
4. PGR: base for reconstruction and re-constellation of new cultivars
5. Exploration and collection: exploration missions - understanding the distribution, ecology,
6. Botany and genetic makeup of each crop species
7. Collection: Patterns of variation and genetic makeup
8. Sample size and collecting efficiency.
9. Collection records: field and laboratory
10. Entering the collected material into the gene bank , Handling the site data.
11. Conservation: ex situ conservation (long term and medium term repositories)
12. Merits and demerits of ex situ conservation
13. In situ conservation - conservation of wild relatives and land races conservation in home gardens - community based plant conservation
14. Botanical gardens and field gene banks - seed saver programmes - National parks
15. Biosphere reserves
16. Relation of in situ conservation to nature conservation and agricultural production
17. Mid Semester Examination
18. Documentation: initial data verification and reorganization
19. Passport data - tasks of the documentation - requirements for documentation
20. Existing data and data to be collected
21. Data processing and information supply
22. Characterization: taxonomic - using plant descriptors

23. Biochemical: using isozymes and DNA markers
24. Evaluation: primary and secondary evaluations
25. Crop Genetic Resources Network : International and National
26. Role of International Agricultural Research Centres (IARCs) in PGR conservation
27. National and Regional PGR centres - Intellectual Property Rights (IPR)
28. PGR - Plant Breeders rights - Farmers rights
29. PGR in strengthening Plant Breeding research system - Central data bases and their features
30. The core collection concept - PGR management - conventional and recent approaches
31. Molecular markers in germplasm management - tracing the pedigree identifying the duplicates
32. Utilization types of collection - PGR exchange - national and international formalities- Plant quarantine check
33. Implications of World Trade Organizations (WTO), General Agreement on Trade and Tariff (GATT), Trade Related Intellectual Property Rights (TRIPs),
34. Plant Variety Protection (PVP) and Convention on Biological Diversity (CBD) on PGR

### **PRACTICAL SCHEDULE**

1. Methodologies for germplasm conservation
2. Exploration and collection: understanding the distribution, ecology, botany and genetic makeup of each crop species
3. Collection: sample size and collecting efficiency interference of new cultivars - Collection records: field and laboratory - Entering the collected material into the gene bank
4. Handling the site data
5. Conservation: ex situ conservation (long term and medium term repositories)
6. In situ conservation of germplasm: various approaches
7. Documentation: initial data verification and reorganization - passport data - requirements for documentation
8. Data processing and information supply
9. Characterization: taxonomic - using plant descriptors
10. Biochemical: using isozymes and DNA markers
11. Evaluation: primary and secondary evaluations
12. Crop Genetic Resources Network: International and National - Role of International Agricultural Research Centres (IARCs) in PGR conservation
13. National and Regional PGR centres
14. Intellectual Property Rights (IPR) and PGR - Plant Breeders rights - Farmers rights - PGR in strengthening Plant Breeding research system
15. Central data bases and their features - The core collection concept - PGR management - conventional and recent approaches
16. Molecular markers in germplasm management - tracing the pedigree - identifying the duplicates
17. Utilization - types of collection - PGR exchange - national and international formalities - Plant quarantine check

### **REFERENCES**

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## **MEL 439 MICROBIAL AND ENVIRONMENTAL TECHNOLOGY (1+1)**

### **OBJECTIVES**

The emphasis of the course will be on bioremediation of soil, bioenergy, biocomposting and microbial insecticides.

## **THEORY**

### **Unit - I: Bioremediation**

Bioremediation of soil polluted with pesticides, fertilizers – Heavy metal pollution – Biotransformation – Hydrocarbon pollution – Super bug – Hydrocarbon extraction - Biomining of metals, Keratin degradation and Rhizoremediation.

### **Unit- II: Microbial food from wastes**

Substrates for Single Cell Protein production – Agricultural wastes – Agro industrial wastes – Domestic wastes – Microorganisms used as Single cell protein – Yeasts, Algae, Molds and Bacteria – Nutritive value – Mass production of *Spirulina* – Uses.

### **Unit-III: Bioenergy**

Renewable and Non – renewable energy. Bioethanol – Microorganisms involved in Bioethanol production – Raw materials for Bioethanol production – Strain improvement techniques – Uses of Bioethanol. Biogas production, Methanogenesis – Microbiology of methane formation in anaerobic digester. Feedstocks – animal wastes and alternative feed stocks, Types and operation of biogas plants – Applications of Biogas.

### **Unit-IV: Microbial Insecticides**

Microbial agents for the control of pests and diseases, Target pest and suitable microbial insecticides, Mode of action of *Bacillus thuringiensis* and Nuclear Polyhedro Viruses, Advantages and limitations of microbial insecticides, Compatibility of microbial and chemical pesticides, Mass production of microbial insecticides. Fermentation - Formulation- Carrier material – Quality control.

### **Unit-V: Biocomposting**

Waste Sources – Types of wastes – Characterization of wastes. Collection, handling and processing of wastes. Techniques in composting – Aerobic and Anaerobic composting – Vermicomposting – Windrow, Coir pith composting – Selection of microbial consortia for composting – Quality standards.

## **PRACTICAL**

Physical and chemical characterization of compost waste materials, Quantitative and Qualitative enumeration of microbes in waste materials, Estimation of CO<sub>2</sub> evolution from decomposition of organic wastes. Aerobic method of composting, Assessment of maturity of compost by physical and chemical methods, Vermiculture of recycling solid wastes. Alcohol production from sugarcane industrial wastes (Molasses), Production of biogas from Agricultural wastes, Production of biogas from alternate feed stocks, Production of Single cell protein using *Spirulina* sp. Estimation of BOD/COD in sugar mill effluent, Estimation of heavy metals in Tannery effluent. Field diagnosis of fungal diseases, viral diseases of insects and bacterial diseases of insects. Mass production of *Bacillus thuringiensis*.

## **THEORY SCHEDULE**

1. Bioremediation of pesticides, fertilizers and heavy metals.
2. Biotransformation – Hydrocarbon pollution and Hydrocarbon extraction.
3. Biomining of metals, Rhizoremediation and Keratin degradation.
4. Substrates for Single cell protein – Agro industrial, Agricultural and Domestic wastes.
5. Microorganisms uses as Single cell protein – Yeasts, Algae, Bacteria and Fungi.
6. Mass production of Single cell protein – Nutritive value and uses.
7. Bioethanol production.
8. Biogas production – Methanogenesis, Feedstocks – Types and operation of Biogas plant.
9. **Mid semester Examination**
10. Microbial Insecticides – Target pests and Suitable insecticides, Mode of infection of BT and NPV.
11. Advantages and limitations of pesticides.
12. Mass production – fermentation, carrier materials – Quality control.
13. Formulation and application of pesticides.
14. Sources of wastes for composting – Physico-chemical properties – nutrient status.
15. Aerobic and anaerobic method of composting.
16. Vermicomposting – Windrow, coir pith composting.
17. Selection of microbial consortia for composting – Quality standards.

## **PRACTICAL SCHEDULE**

1. Physical and chemical characterization of compost waste materials.
2. Quantitative and Qualitative enumeration of microbes in waste materials.
3. Estimation of CO<sub>2</sub> evolution from decomposition of organic wastes.

4. Aerobic method of composting.
5. Assessment of maturity of compost by physical and chemical methods.
6. Vermiculture of recycling solid wastes.
7. Alcohol production from sugarcane industrial wastes (Molasses).
8. Production of biogas from Agricultural wastes.
9. Production of biogas from alternate feed stocks.
10. Production of Single cell protein using *Spirulina* sp.
11. Estimation of BOD/COD in sugar mill effluent.
12. Estimation of heavy metals in Tannery effluent.
13. Field diagnosis of fungal diseases of insects.
14. Field diagnosis of viral diseases of insects.
15. Field diagnosis of bacterial diseases of insects.
16. Mass production of *Bacillus thuringiensis*.
17. **Final practical examination**

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1. Asthana, D.K and Meera Asthana, 2007. A text book of Environmental studies, S. Chand & Company Ltd., New Delhi.
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## MEL 440 GROWTH AND DEVELOPMENT OF HORTICULTURAL CROPS (1+1)

### OBJECTIVES

Growth is an outward expression of different physiological processes that continuously proceed in plants. This course outlines the different growth functions, flowering, fruit development and senescence in plants which will help the students to assess the time and methods of application of different horticultural practices.

### THEORY

#### Unit-I : Growth and growth analysis

Parameters of growth and development – types of growth cycles in horticultural crops – seed germination and seed dormancy – physiology of root formation in cuttings and grafts – graft incompatibility – vegetative physiology – bud dormancy – bud breaking – shoot types – canopy development – physiological basis of training and pruning.

#### Unit –II: Physiological Process of Flowering, Bulb and Fruit development

Flowering – Factors affecting – physiology of flowering – photoperiodism – vernalisation and its application in Horticulture – Flower drop – Physiological basis of bulb, tuber and fruit development – pollination – fertilization – seedlessness – fruit drop – control – physiology and biochemistry of ripening – climacteric and non climacteric fruits.

#### Unit-III : Role of Macro and Micronutrients on plant growth

Physiological functions of macro and micro nutrients for plant growth – mobility and forms of absorption – indicator plants – deficiency symptoms of macro and micro nutrients in Horticultural crops – Leaf sampling for tissue analysis – correction measures of nutrient deficiency – foliar absorption – importance and mechanism of absorption – physiological disorders in fruits and vegetables – identification and correction – internal corrections – source – sink relationship.

#### Unit-IV: Role of plant growth regulators in Horticultural crops

Plant hormones – Auxin, gibberellin, cytokinin, ethylene – biosynthesis – distribution – basic functions in plants – synthetic forms of plant hormones – growth retardants – inhibitors – its role in crop growth and development – role of plant growth regulators in propagation, flowering, fruit setting, fruit development and fruit ripening.

#### Unit-V: Senescence and Stress physiology

Senescence – mechanism – biochemical and physiological changes – longevity of leaves in perennial and annual crops – stress physiology – heat, cold, moisture and salinity stresses – post harvest physiology in Horticultural crops.

### PRACTICAL

Estimation of photosynthetic potential of Horticultural crops – leaf area index – light intensity measurement in different tier cropping – growth analysis parameters including harvest index – preparation of hormonal solution and induction of rooting in cuttings – ripening of fruits and control of fruit and flower drop. Senescence index in plants – basic principles in identifying the deficiency symptoms of macro and micro elements in fruits, vegetables and flower crops – important physiological disorders and their remedial measures in fruits and vegetables – seed dormancy – tetrazolium test – seed germination and breaking seed dormancy with chemicals and growth regulators

### **THEORY LECTURE SCHEDULE**

1. Growth expression, factors influencing growth, types of growth
2. Physiology & biochemistry of perennial, semi perennial and annuals
3. Dormancy, bud break in horticultural crops, their importance, Physiology of rooting of cuttings and graft incompatibility.
4. Flowering – factors affecting – physiology of flowering, photoperiodism – long day, short day, day neutral plants, vernalization
5. Phase transition juvenile, vegetative, reproductive interface
6. Pollination – fertilization – seedlessness – fruit drop control – ripening – climacteric and non climacteric fruits
7. Functions of macro and micro nutrients for plant growth, absorption, nutrients deficiency symptoms, leaf sampling for tissue analysis
8. Induction of fruit set Apomixis, parthenocarpy and their physico chemical basis
9. Mid semester examination
10. Physico-chemical phenomena of pruning on flowering and fruiting
11. Physico-chemical phenomena of training on flowering and fruiting
12. Plant hormones –Auxin, gibberellins, cytokinin, ethylene – basic functions in plants
13. Bio-synthesis, growth retardants, inhibitors, role of growth and development and PGR's.
14. Propagation, flowering, fruit setting, fruit development and ripening.
15. Mechanism of senescence, longevity of leaves in perennial and annual crops.
16. Stress physiology – heat, cold, moisture and salinity
17. Post harvest physiology in fruits, vegetables and flower crops.

### **PRACTICAL SCHEDULE**

1. Observation on growth in different Horticultural crops
2. Components of growth analysis
3. Measurement of growth due to environmental factors and correlation of the same with growth
4. Experiments on seed germination – Tetrazolium test.
5. Use of chemicals in breaking bud dormancy
6. Use of cultural practices in bud break
7. Field visit to study the training and pruning practices in horticulture crops
8. Observation on different Horticultural floral materials on fruit set
9. Maturation induction through growth regulators
10. Crop regulation factors like pinching, pruning & training in young horticultural plants.
11. Identification of plant growth regulators
12. Use of PGR.'s in fruits and vegetables
13. Use of chemicals for ripening and induction of rooting in cuttings
14. Use of chemicals for controlling the flower and fruit drop
15. Identification of deficiency symptoms of fruits and vegetables
16. Use of growth retardants in selected horticultural crops
17. Experiments on post harvest losses in fruits and vegetable crops

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## **MODULE V COMMERCIAL HORTICULTURE**

### **MEL 441 NURSERY MANAGEMENT OF HORTICULTURAL CROP (2+1)**

#### **OBJECTIVES**

This course deals with different methods of plant propagation and strategies for nursery management of various fruit crops. Knowledge of tools and implements is essential to carry out all scientific horticultural operations and also nursery management practices. The above themes are discussed elaborately in this course and the basic knowledge gained will be useful for the career development.

#### **THEORY**

##### **Unit-I: Methods of Propagation**

Propagation - overview - sexual and asexual methods of propagation - advantages and disadvantages of seed and vegetative propagation- Methods of dormancy alleviation and seed treatment methods.

##### **Unit-II: Principles and Methods of Seed Propagation**

Seed propagation - seed dormancy, internal and external factors - nursery techniques- apomixis - monoembryony, polyembryony- principles - utilization Pro-trays, Nursery beds, Community Nursery Development- Propagation of Transplanted vegetables and Annual flowering seeds- Maintenance of young seed propagated plants.

##### **Unit-III: Propagation Structures**

Propagation structures - mist chamber - green houses - glass houses - pit nursery tools and implements - use of growth regulators in seed and vegetative propagation - physiological and anatomical basis of vegetative propagation.

##### **Unit-IV: Asexual Propagation Techniques**

Methods and techniques of cuttings, layering, grafting and budding - factors influencing rooting of cuttings, layering, budding - grafting - stock scion relationship root stock influences - bud wood selection - bud wood certification techniques. Propagation through specialized organs - tuber, bulb, corm, bulbils, rhizome, runner, offshoot, crown, slip, sucker and micro propagation.

##### **Unit-V: Nursery Management**

Selection of Land for Nursery Establishment- Nursery lay out and Planning- Mother plant Nursery- Collection of Mother Plants- Marking techniques and labeling of Mother plants- Pruning and training of Mother plants for propagation – Nursery Materials, Inputs, management and pricing- Cost Estimate and Budgeting.

#### **PRACTICAL**

Potting medium - tools, implements and containers for propagation of nursery beds - propagation structures - potting - repotting - mist chambers and pit nursery raising of rootstocks and scion preparation- different techniques and practices of cutting, layering, grafting and budding - use of specialized organs - rejuvenation - visit to private nurseries and tissue culture laboratory - working out economics.

#### **THEORY LECTURE SCHEDULE**

1. Study of sexual and asexual methods of propagation.
2. Advantages and disadvantages of seed and vegetative propagation.
3. Seed dormancy – factors affecting dormancy – Internal and external factors affecting dormancy
4. Types of dormancy
5. Methods of dormancy alleviation and treatments.
6. Apomixis and its application in Nursery production
7. Mono and Polyembryony and its application in Nursery production
8. Pro-trays, Nursery beds,
9. Community Nursery Development-
10. Propagation of Transplanted vegetables and Annual flowering seeds
11. Maintenance of young seed propagated plants
12. Study of propagation structures and mist-chambers.
13. Construction of green houses and glass houses controlling system.

14. Study about pit nursery techniques
15. Important tools and implements.
16. Use of growth regulators in seed and vegetative propagation
17. **Mid – semester**
18. Types of cuttings and techniques of preparation
19. Types of layering and techniques of preparation
20. Grafting and budding methods and techniques of preparation.
21. Stock scion relationship and factors governing.
22. Influence of root stock on scion-bud wood selection and certification
23. Study about propagation by specialized plant parts - bulbs and tubers.
24. Study about propagation by specialized plant parts - Runners, suckers and other organs.
25. Study about micro propagation techniques including Tissue Culture.
26. Selection of Land for Nursery Establishment
27. Nursery lay out and Planning
28. Mother plant Nursery
29. Collection of Mother Plants
30. Marking techniques and labeling of Mother plants
31. Pruning and training of Mother plants for propagation
32. Nursery Materials, Inputs, management and pricing
33. Cost Estimate and Budgeting.
34. Project preparation for establishment of Commercial Nursery

### **PRACTICAL SCHEDULE**

1. Preparation of nursery beds, seed treatment and sowing.
2. Identification of various tools and implements.
3. Practices in potting and repotting.
4. Preparation of pot mixture and study of various containers.
5. Study of special structures for propagation.
6. Raising of rootstocks and scion preparation.
7. Mist propagation techniques.
8. Practice in propagation by cuttings.
9. Practice in propagation by layering.
10. Practicing budding methods.
11. Practicing grafting methods.
12. Use of growth regulators in propagation.
13. Practices in separation and description of plant parts used for propagation.
14. Rejuvenation, top working and bridge grafting.
15. Practice in micro propagation and Hardening methods.
16. Visit to tissue culture laboratory and controlled green houses.
17. Visit to private nurseries

### **REFERENCE BOOKS**

1. Bose, ToK., SoK. Mitra and M.K. Sadhu, 1991. Propagation of Tropical and Subtropical Horticultural Crops, Naya Prakash Publications, Calcutta.
2. Hartmann, HoT. and D.E. Kester, 1988. Plant Propagation - Principles and Practices, Prentice Hall of India, New Delhi.
3. Prasad, So and V. Kumar, 1999. Green House Management of Horticultural Crops, Agro-Bios India, Jodhpur.
4. Reddy, Y.T.N., T. Janakiram and D. Satyanarayana Reddy, 2001. Scientific Nursery Management, The House of Sarpan (Media), Bangalore.
5. Singh, SoP. 1983. Mist Propagation, Metropolitan Book Company, New Delhi.

## **MEL 442 PROTECTED CULTIVATION OF HORTICULTURAL CROPS (2+1)**

### **OBJECTIVES**

This course aims to understand 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 measurements to control light, temperature, relative humidity and CO<sub>2</sub> 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: Scope and Constraints of Protected Cultivation**

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: Environmental Control in Green Houses**

Green House - Growing media - Pre plant treatment of media - Green House benches - Green House Environmental control systems - Temperature control- Cooling system. Heating system - Light - Photoperiod manipulation - configuration.

### **Unit-III: Irrigation and Fertilizer Management**

Green House - Irrigation - Types . planning, designing, Installation, operation and maintenance - Fertilizer Sources - Fertigation, Water soluble fertilizers - application method - Fertilizer programmes for vegetables and flowers - Hydroponic systems Nutrient Film Technique ( NFT).

### **Unit-IV: Cultural Management Under Protection**

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: Quality Management and Marketing**

Harvesting - Grading - Packaging - Transport - International standards for various horticultural commodities - Role of corporate sector in Horticulture - Agencies involved in Export promotion of Horticultural crops.

## **PRACTICAL**

Components of polyhouse - working out the efficiency of thermo control systems media for high - tech culture - soilless culture - Nutrient Film Technique (NFT) fertigation programme for various crops - description of roofing material - visit to polyhouses - description of cold fogger - ultra low to high capacity foggers - micro mist systems - description of ventilation equipments - survey of exportable horticultural produces - packaging techniques for various commodities - packaging materials for processed and fresh products - post harvest handling of exportable commodities.

## **THEORY LECTURE SCHEDULE**

1. Introduction to protected cultivation - advantages and disadvantages.
2. Modes of protected cultivation
3. Present status of green house cultivation in India - Constraints and scope
4. Site selection for green house and structural designs
5. Arrangement of green houses - styles - single and multispans
6. Green house roofing materials
7. Green house media, natural and synthetic and sterilization
8. Green house - beds and benches construction and space use efficiency
9. Temperature control- heating - cooling - lighting
10. Cooling methods, ventilations - Evaporate cooling - Air conditioning
11. Light - measurement - Units - sources and quality.
12. Light manipulation - colour and duration - configuration
13. Types of irrigation in green house - purpose and advantage
14. Planning, designing and installation of micro irrigation system.
15. Operation and maintenance of irrigation system
16. Fertigation - advantages - water soluble fertilizer
- 17. Mid Semester Examination.**
18. Fertilizer methods and fertilizer requirement for various green house crops.
19. Hydroponics - definition and methods and scope - Nutrient film techniques -
20. Nutrient solution - aggregate hydroponics
21. Bedding industry - plug production - modular containers
22. Mechanical fillers - media and seeders.
23. Seed priming, pelleting, coating and growth chambers
24. Liners, microliners - root trainers and fertilizer requirement of lines and microliners.
25. Training and pruning methods of green house flower and vegetables.
26. Insect and disease control methods - vaporization - thermal fogging - Smoking
27. Post harvest management of green house crops - Harvest index
28. Conditioning - grading - precooling.
29. Cold storage - cool chain concept.
30. Containers for packing - dry packing - net packing
31. Preservative solutions - germicides - plant growth regulators.
32. Grade standards - International - National - Organizations.
33. Procedures for starting export oriented Units



34. Commodity boards - Promotional schemes - Role of Corporates.

### **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 system
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 on benches
11. Study of fertilization methods and Fertilizer calculation
12. Economics of green house cultivation of Rose
13. Economics of green house cultivation of gerbera and carnation
14. Economics of green house cultivation of Anthurium and Orchids
15. Procedures for starting export oriented Units
16. Grade standards and preservative solution for various cutflowers
- 17. Practical Examination**

### **REFERENCE BOOKS**

1. Ellis, C. 1999. Soilless Culture of Horticulture Plants Agrobios, India. Jodhpur.
2. James Lr. Boodley, 1981. The Commercial Green House, Ball Publishing, USA.
3. Paul V. Nelson, 1991. Green House Operation and Management, Ball Publishing., USA.
4. Prasad, S. and V. Kumar. 1999. Green House Management for Horticultural Crops, Agrobios India, Jodhpur.
5. Robert, A. Aldrich and John W. Bartok, Jr. 1990. Green House Engineering, Balt Publishing, USA.
6. Benten Jones. 2005, Hydroponics: a practical guide for the soilless grower, Volume 1. CRC Press

## **MEL 443 POST HARVEST TECHNOLOGY OF HORTICULTURAL CROP (2+1)**

### **OBJECTIVES**

India is considered to be the second largest producer of fruits and vegetables and in the world. In spite of higher production achieved in the field of horticultural crops, considerable gap exists between gross production and net availability of fruits and vegetables due to huge post harvest loss. These loss are again due to lack of knowledge in the proper post harvest management or handling of fruit and vegetables right from harvesting to marketing. To overcome these bottlenecks, fruits and vegetables could be profitably disposed either by storing them in cold rooms or by processing and preserving them as different products.

Horticultural produces offer tremendous scope for value addition in to different products with commercial feasibility. The content of this course is so designed that it will help the students to become an entrepreneur in this potential area.

### **THEORY**

#### **Unit-I : Post harvest handling and ripening physiology**

Importance of post harvest technology and causes of post harvest losses – Maturity indices and time of harvesting – pre and post harvest physiological changes in Horticultural produce – methods to hasten or delay ripening of fruits.

#### **Unit-II : Post harvest treatments and storage**

Handling methods – pre-cooling, washing and grading – waxing – vapour heat treatment – irradiation – fumigation – storage methods – hypobaric , controlled and modified atmospheric storage techniques – storage disorders – handling of cut flowers – shelf life extension- Cold chain maintenance.

#### **Unit –III : Packaging of Horticultural produce**

Packaging of horticultural produce – type of containers and packaging materials – methods of packing – controlled and modified atmospheric packaging – vaccum, edible packaging. Role of NHB, APEDA, Plant Quarantine and other certifying agencies governing internal and foreign trade of harvested produce.

#### **Unit – IV : Methods of preservation**

Status and scope of fruit and vegetable processing industries in India – Principles of preservation – Preservation with sugar, salt – heat preservation – chemicals or bio-preservatives, dehydration and fermented beverages.

#### **Unit – V: Value added products and quality control**

Value added products – spice oil, oleoresin, curry powder – dehydrated and ground spice – consumer packed spices – waste and by product utilization from processing industry – quality control standards – BIS, AGMARK, Codex Alimentarius – Fruit products order (FPO).

### **PRACTICAL**

Practice in judging the maturity of various horticultural crops – studies on harvesting or delaying ripening of treated produce. Types of packaging materials and packaging methods – Equipments in food processing unit – preparation of squash, jam, RTS, syrup, candy, ketchup, sauce, pickles, chutney (hot and sweet), dehydrated products, brining – comparative study of ambient and refrigerated storage – visit to food processing units.

### **THEORY LECTURE SCHEDULE**

1. Importance and scope of post harvest technology of horticulture crops.
2. Post harvest losses,
3. Maturity indices
4. Pre and post harvest physiological changes during development, maturity and ripening of fruits.
5. Post harvest treatments - pre-cooling, washing,
6. Post harvest treatments - grading waxing, vapourheat treatment.
7. Irradiation of fruits and vegetables
8. Fumigation.
9. Storage methods, controlled atmospheric storage –
10. Modified atmospheric storage
11. Sstorage disorders.
12. Handling of cut flowers
13. Cold chain maintenance
14. Methods to extend the shelf life of flowers.
15. Packaging methods of fruits and vegetables
16. Packaging materials.
- 17. Mid Semester Examination**
18. Controlled and modified atmospheric packaging.
19. Vacuum and edible packaging.
20. Role of NHB, APEDA
21. plant Quarantine and other certifying agencies governing internal and foreign trade of harvested produce.
22. Importance and scope of vegetable preservation industry in India
23. Principles of preservation.
24. Preservation with sugar and salt
25. Preservation with chemicals and bio-preservatives.
26. Sterilization – pasteurization –
27. Dehydration.
28. Principles of preservation by fermentation
29. Canning.
30. Value added products from spices
31. By-product utilization from processing industry.
32. Quality control standards – Role of BIS, AGMARK,
33. CodexAlimetarius
34. Fruits products order (FPO)

### **PRACTICAL SCHEDULE**

1. Practice in Judging the maturity of horticultural produce
2. Use of polyethylene bags in prolonging shelf life of perishables.
3. Wax coating and packaging studies for fruit,
4. Wax coating and packaging in vegetables
5. Post harvest packaging in cut flowers.
6. Identification and study of working of equipments used in processing units.
7. Preparation of squash
8. Preparation of RTS and syrup.
9. Preparation of Jam
10. Preparation of Jelly and marmalade
11. Preparation of Sauce
12. Preparation of ketch-up
13. Preparation of pickles
14. Dehydration of Vegetables and Fruits
15. Visit to food processing units

16. Comparative study of ambient and refrigerated storage

## 17. Practical Examination

### REFERENCE BOOK

1. Giridharilal, G.S. Siddappa and G.L. Tandon. 2000. Preservation of fruits and vegetables. Publication and information division. ICAR, New Delhi.
2. Srivastava, R. P and Sanjeevkumar. 1998. Vegetable preservation principles and practices. International Book distributing Co. Lucknow.
3. Jacob John, P. 2008. A Hand book of Post harvest management of fruits and vegetables. Daya publishing house, New Delhi.
4. Ashwani, K., Goel, Rajender kumar, Satwinder, S. Mann. 2007. Post harvest management and value addition. Daya publishing house, New Delhi.
5. Sudheer, K.P. and V. Indira. 2007. Post harvest technology of horticultural crops, New India Publishing Agency, New Delhi.

## MEL 444 MICROBIAL AND ENVIRONMENTAL TECHNOLOGY (1+1)

### OBJECTIVES

The emphasis of the course will be on bioremediation of soil, bioenergy, biocomposting and microbial insecticides.

### THEORY

#### Unit - I: Bioremediation

Bioremediation of soil polluted with pesticides, fertilizers – Heavy metal pollution – Biotransformation – Hydrocarbon pollution – Super bug – Hydrocarbon extraction - Biomining of metals, Keratin degradation and Rhizoremediation.

#### Unit- II: Microbial food from wastes

Substrates for Single Cell Protein production – Agricultural wastes – Agro industrial wastes – Domestic wastes – Microorganisms used as Single cell protein – Yeasts, Algae, Molds and Bacteria – Nutritive value – Mass production of *Spirulina* – Uses.

#### Unit-III: Bioenergy

Renewable and Non – renewable energy. Bioethanol – Microorganisms involved in Bioethanol production – Raw materials for Bioethanol production – Strain improvement techniques – Uses of Bioethanol. Biogas production, Methanogenesis – Microbiology of methane formation in anaerobic digester. Feedstocks – animal wastes and alternative feed stocks, Types and operation of biogas plants – Applications of Biogas.

#### Unit-IV: Microbial Insecticides

Microbial agents for the control of pests and diseases, Target pest and suitable microbial insecticides, Mode of action of *Bacillus thuringiensis* and Nuclear Polyhedro Viruses, Advantages and limitations of microbial insecticides, Compatibility of microbial and chemical pesticides, Mass production of microbial insecticides. Fermentation - Formulation- Carrier material – Quality control.

#### Unit-V: Biocomposting

Waste Sources – Types of wastes – Characterization of wastes. Collection, handling and processing of wastes. Techniques in composting – Aerobic and Anaerobic composting – Vermicomposting – Windrow, Coir pith composting – Selection of microbial consortia for composting – Quality standards.

### PRACTICAL

Physical and chemical characterization of compost waste materials, Quantitative and Qualitative enumeration of microbes in waste materials, Estimation of CO<sub>2</sub> evolution from decomposition of organic wastes. Aerobic method of composting, Assessment of maturity of compost by physical and chemical methods, Vermiculture of recycling solid wastes. Alcohol production from sugarcane industrial wastes (Molasses), Production of biogas from Agricultural wastes, Production of biogas from alternate feed stocks, Production of Single cell protein using *Spirulina* sp. Estimation of BOD/COD in sugar mill effluent, Estimation of heavy metals in Tannery effluent. Field diagnosis of fungal diseases, viral diseases of insects and bacterial diseases of insects. Mass production of *Bacillus thuringiensis*.

### THEORY SCHEDULE

1. Bioremediation of pesticides, fertilizers and heavy metals.
2. Biotransformation – Hydrocarbon pollution and Hydrocarbon extraction.
3. Biomining of metals, Rhizoremediation and Keratin degradation.
4. Substrates for Single cell protein – Agro industrial, Agricultural and Domestic wastes.
5. Microorganisms uses as Single cell protein – Yeasts, Algae, Bacteria and Fungi.

6. Mass production of Single cell protein – Nutritive value and uses.
7. Bioethanol production.
8. Biogas production – Methanogenesis, Feedstocks – Types and operation of Biogas plant.
- 9. Mid semester Examination**
10. Microbial Insecticides – Target pests and Suitable insecticides, Mode of infection of BT and NPV.
11. Advantages and limitations of pesticides.
12. Mass production – fermentation, carrier materials – Quality control.
13. Formulation and application of pesticides.
14. Sources of wastes for composting – Physico-chemical properties – nutrient status.
15. Aerobic and anaerobic method of composting.
16. Vermicomposting – Windrow, coir pith composting.
17. Selection of microbial consortia for composting – Quality standards.

### **PRACTICAL SCHEDULE**

1. Physical and chemical characterization of compost waste materials.
2. Quantitative and Qualitative enumeration of microbes in waste materials.
3. Estimation of CO<sub>2</sub> evolution from decomposition of organic wastes.
4. Aerobic method of composting.
5. Assessment of maturity of compost by physical and chemical methods.
6. Vermiculture of recycling solid wastes.
7. Alcohol production from sugarcane industrial wastes (Molasses).
8. Production of biogas from Agricultural wastes.
9. Production of biogas from alternate feed stocks.
10. Production of Single cell protein using *Spirulina* sp.
11. Estimation of BOD/COD in sugar mill effluent.
12. Estimation of heavy metals in Tannery effluent.
13. Field diagnosis of fungal diseases of insects.
14. Field diagnosis of viral diseases of insects.
15. Field diagnosis of bacterial diseases of insects.
16. Mass production of *Bacillus thuringiensis*.
- 17. Final practical examination**

### **REFERENCE**

- 1) Asthana, D.K and Meera Asthana, 2007. A text book of Environmental studies, S. Chand & Company Ltd., New Delhi.
- 2) Dara, S.S. 1993. A text book of Environmental chemistry and pollution control. S. Chand and company Ltd, New Delhi.
- 3) Gabriel Bitton, 2005. Waste water Microbiology. John Wiley & sons. Inc., Publication, Florida.
- 4) Krishnan Kannan, 1991. Fundamentals of Environmental pollution, S. Chand and Co., Ltd., New Delhi.
- 5) Raina M Maier, Ian L. Pepper and Charles P. Gerba, 2006. Environmental Microbiology. Academic Press, California, USA.
- 6) Vijaya Ramesh, K. 2008. Environmental Microbiology, MJP Publishers, Chennai.

## **MEL 445 SEED PRODUCTION OF HORTICULTURE CROPS (1+1)**

### **OBJECTIVES**

- To understand the quality seed production methods of varieties and hybrids of horticultural crops.
- It impart the importance of seed certification.

### **THEORY**

#### **Unit –I : Seed Morphology and Classification of seed**

Seed – structure and texture – monocot – dicot seeds and their importance – Characteristics of good quality seeds – seed multiplication systems – different classes Seed

#### **Unit -II Principles of seed production**

Influence of agro climatic condition on seed production – selection of seed production area, varietal release – state and central variety releasing committee.

#### **Unit – III: Seed Production**

Principles and methods of seed production in self and cross pollinated crops – varieties and hybrids of Tomato, Brinjal, Chillies, Bhendi, Amaranthus, Gourds, Cabbage, Cauliflower, Radish, Carrot, Onion,

#### **Unit - IV: Post Harvest Technology**

Harvesting and post harvest technology – methods of harvesting – drying- principles of seed processing – dormancy – methods of seed treatment

#### **Unit – V : Seed Certification and seed legislation**

seed standard – seed certification – organization – seed certification procedure, seed Act and seed rules and seed regulation.

#### **PRACTICAL**

Seed structure and texture – Monocot – Dicot seeds - Seed identification – identification of improved varieties – seed certification – field inspection – visiting seed production plots –supplementary pollination- planting ratio and planting design-isolation and rogueing- Physiological and harvestable maturity - harvesting and seed extraction -Packaging materials– godown sanitation.

#### **THEORY LECTURE SCHEDULE**

1. Seed structure and texture – Monocot – Dicot seeds and their importance
2. Characteristics of good quality sttdes – seed multiplication system
3. Influence of agro climatic condition of seed production – selection of seed production area.
4. Varietal release – state and central variety releasing committee
5. Different classes of seeds
6. Methods of seed production in self and cross pollinated crops.
7. Seed production methods in varieties and hybrids of Tomato and Brinjal
8. Seed production methods in varieties and hybrids of Chillies and Bhendi
9. Seed production methods in varieties and hybrids of Amaranthus
10. Seed production methods in varieties and hybrids of Gourds
11. Seed production methods in varieties and hybrids of Cabbage and Cauliflower
12. Seed production methods in varieties and hybrids of Onion
13. Seed dormancy-Classification - treatment to overcome dormancy
14. Seed treatment
15. Seed certification – organizations involved in certification
16. seed certification procedure

#### **PRACTICAL SCHEDULE**

1. Seed structure of monocot & Dicot seeds
2. Seed identification of improved varieties of hybrid of vegetable crops
3. State and central variety release
4. Visit to seed production plots
5. Supplementary pollination
6. Planting ratio and planting design for horticultural crops
7. Isolation and rogueing
8. Physiological and harvesttable maturity – indices of maturity
9. Harvesting and seed extraction
10. Visit to seed processing unit
11. Seed certification
12. Visit to state seed certification agency
13. Seed storage of horticultural crops
14. Packaging materials
15. Godown sanitation
16. Practical Examination.

#### **REFERENCE BOOK**

1. Agarwal RL. 1997. Seed Technology. 2<sup>nd</sup> Ed. Oxford & IBH
2. Marcle Dekker. Georage RAT. 1980. Vegetable Seed Technology. A Technical Guide to Vegetable Seed Production, Processing, Storage and Quality Control. FAO, Rome.
3. McDonald MB Jr & Copeland LO. 1997. Seed Production of Crops: Principles and Practicees. Chapman & Hall.
4. Singh SP. 2001. Seed Production of Commercial Vegetables. Agrotech.
5. Singhal NC. 2003. Hybrid Seed Production in Field Crops. Kalyani, Publisher.

### **MODULE VI AGRI-BUSINESS PROCESS DEVELOPMENT**

#### **MEL 446 PROJECT FORMULATION, EVALUATION AND MONITORING (2+1)**

## OBJECTIVES

The objective of this course is to provide knowledge to the students on project selection, formulation, financial feasibility analysis, monitoring and evaluation techniques with special reference to agricultural sector.

## THEORY

### Unit I: Introduction to Project Management

Project – Definition - Characteristics - Project Cycle - Classification, identification – Formulation. Feasibility Study - Economic and Market Analysis - Environmental Impact Study - Financial Analysis - Risk and Uncertainty - Project Appraisal - Detailed Project Report.

### Unit II: Organizational Project Management

Project Organization Design - Human Resource Management - Role Management - Team Building – Communication – Motivation - Decision – Making Leadership.

### Unit III: Project management Techniques

Project Management - Bar Chart - Milestone Chart – Networks - PERT - Network Diagram - Computation of EST & LST - Network Revision - Time-Cost Relationship of an Activity Project Crashing - Project Control.

### Unit – IV: Monitoring

Monitoring – Introduction – basic elements -Importance - Monitoring and progress reporting – monitoring techniques -Indicators for monitoring -Types of monitoring - Monitoring risk uncertainties

### Unit – V: Evaluation

Evaluation – Definition - Introduction – Features – Importance - Comparison of appraisal, monitoring and evaluation-Types of Evaluation -Designing monitoring and Evaluation system- Salient aspects of evaluation-Quantitative and Qualitative approaches- Participatory monitoring and Evaluation-Social audit-Evaluation report.

## PRACTICAL

Developing skills in identification of projects – formulation of projects – measuring of cost and benefit of projects – appraisal of project using undiscounted and discounted techniques – use of sensitivity analysis – selection methods among mutually exclusive projects – preparation of case studies – social cost benefit analysis – developing network techniques for project management – use of management tools in project monitoring – analyzing risk in projects – Environmental Impact Assessment.

## THEORY LECTURE SCHEDULE

1. Introduction - Project Definition
2. Project Characteristics – Project Performance dimensions
3. Project Life Cycle – Conceptualization – Planning – Execution Phases
4. Project Classification
5. Project Identification – Formulation.
6. Feasibility Study - Economic and Market Analysis - Environmental Impact Study
7. Financial Analysis – Pay back Period – ROI – NPV - IRR
8. Risk and Uncertainty – Economic Benefit – Management Aspects
9. Project Appraisal – Market – Technical – Economic Appraisal
10. Detailed Project Report
11. Project Organization Design
12. Human Resource Management - Role Management
13. Team Building – Communication
14. Motivation - Decision – Making Leadership.
15. Project Management - Bar Chart - Milestone Chart
16. Networks - PERT - Network Diagram
17. **Mid-Semester Examination**
18. Computation of EST & LST - Network Revision
19. Time-Cost Relationship of an Activity
20. Project Crashing - Project Control.
21. Monitoring – Introduction – basic elements -Importance
22. Monitoring and progress reporting – monitoring techniques
23. Indicators for monitoring
24. Types of monitoring
25. Monitoring risk uncertainties
26. Evaluation – Definition - Introduction – Features – Importance
27. Comparison of appraisal, monitoring and evaluation
28. Types of Evaluation
29. Designing monitoring and Evaluation system

30. Salient aspects of evaluation
31. Quantitative and Qualitative approaches
32. Participatory monitoring and Evaluation
33. Social audit
34. Evaluation report

#### **PRACTICAL SCHEDULE**

1. Developing skills in identification of projects
2. Formulation of projects
3. Measuring of cost and benefit of projects
4. Appraisal of project using undiscounted and discounted techniques
5. Use of sensitivity analysis
6. Selection methods among mutually exclusive projects
7. Selection methods among mutually exclusive projects
8. Preparation of case studies
9. Preparation of case studies
10. Social cost benefit analysis
11. Networks - PERT - Network Diagram
12. PERT – CPM analysis
13. Time-Cost Relationship of an Activity
14. Developing network techniques for project management
15. Use of management tools in project monitoring
16. Analyzing risk in projects
17. Environmental Impact Assessment.

#### **REFERENCE BOOKS**

1. Chalmers, James, 2002. *How to Manage Project*, Jaico Publishing House, Mumbai.
2. Chandra, Prasanna, 1995. *Projects: Preparation, Appraisal, Budgeting and Implementation*, Tata McGraw Hill Publications, New Delhi.
3. Gittinger, Price J., 1982. *Economic Analysis of Agricultural Projects*, The John Hopkins University Press, London.
4. Goel, B.B., 1989. *Project Management*, Deep & Deep Publications, New Delhi.
5. Little I.M.D., and J.A. Mirlees, 1974. *Project Appraisal and Planning for Developing Countries*, Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi.

## MEL 447 MANAGEMENT OF AGRO BASED INDUSTRY(2+1)

### OBJECTIVES

The objective of this course is to provide knowledge to the students on efficient management strategies for food processing industries and policies related to food processing industries.

### THEORY

#### Unit-I: Food Processing Industries an Overview

Food processing industries - definition - scope - management - organized - unorganized - indigenous - history of food processing industries in India - international scenario of food processing industries.

#### Unit-II: Classification Food Processing Industries

Classification food processing industries - agriculture - horticulture - medicinal - aromatics - plantation - animal husbandry and fisheries - dairy, fruits and vegetable processing - grain processing - meat and poultry processing - fisheries and - consumer foods including packaged foods, beverages and packaged drinking water.

#### Unit-III: Marketing and scope of the Processed foods

Raw material procurement, problems, marketing of the processed foods, distribution logistics, promotional tools, pricing techniques, branding, problems in marketing, failures and reasons, success stories of food industry – strategies to be followed – Government policies.

#### Unit-IV: Food Safety and Training

Management of food safety and training - total quality management food processing machineries - organic food product manufacturing and management, certification and marketing pest control basic - food plant security - minimizing sabotage - food plant self – inspections – food processing institute – MOFPI – IICPT .

#### Unit-V: Policies Related to Food Processing Industries

National and international policies profile of domestic and overseas players - institutions - CII- CSIR - FAQ - SPS - ISO - FPO - codex alimentaries - HACCP – GMP – GHP - international standards BRC, IFS, GFSI, ISO 22000, NFPA. National and international subsidies - certification procedures - cost-guide lines and consultancy

### THEORY SCHEDULE

1. Food Processing Industries - definition - scope - management organized - unorganized patented - packaged - aerated - alcoholic beverages - nutritive foods
2. Indigenous - patented - packaged - aerated - alcoholic beverages - nutritive foods
3. History of food processing industries in India
4. International scenario of food processing industries
5. Classification food processing industries - agriculture
6. Horticultural food processing industries
7. Medicinal - aromatics - plantation
8. Animal husbandry and fisheries
9. Dairy, fruits and vegetable processing
10. Grain processing
11. Meat and poultry processing - fisheries
12. Raw material procurement, problems
13. Marketing of the processed foods
14. Distribution logistics, Promotional tools
15. Pricing techniques, Branding
16. Consumer foods including packaged foods
17. **Mid Semester Examination**
18. MOFPI - policies
19. National and international policies
20. Food processing institutes in India
21. Institutions - IICPT
22. Council of scientific and industrial research
23. FAQ- SPS
24. ISO
25. FPO, codex alimentaries
26. HACCP
27. Value addition
28. Minimization of wastage -
29. National and international subsidies
30. Management of food safety and training
31. Total quality management



32. Food processing machineries
33. Organic food product manufacturing and management
34. Certification and marketing

## **PRACTICAL**

Programmes and policies of MOFPI – IICPT - cereal processing, pulses processing, oil seed processing, live stock processing, sugar and horticulture processing, by product processing industries. Setting up of new processing plant – modernization / expansion / up gradation – integrated cold chain - Food parks - National Institute of Food Technology Entrepreneurship and Management - National Meat and Poultry Processing Board - Indian Grape Processing Board, Pune. Visit to herbaceuticals and various preliminary processing industries. Study on cattle feed manufacturing, honey processing, bakery, alcohol, non traditional industries. Organic certification and export procedures. Market potential for food processing industries - food safety rules and regulations - Value addition - Minimization of wastage - AEZ in India – Floriculture -

## **PRACTICAL SCHEDULE**

1. Management of cereal processing industries, pulses
2. Setting up of new processing plant
3. Modernization / expansion / up gradation
4. Integrated cold chain - Food parks
5. National Institute of Food Technology Entrepreneurship and Management
6. National Meat and Poultry Processing Board
7. Indian Grape Processing Board, Pune.
8. Visit to herbaceuticals processing industries / Visit to export commodities processing industries
9. Management of cattle feed manufacturing industries
10. Role of non traditional industries
11. HACCP - Food processing training institutes
12. Case studies in food processing industries
13. Organic certification & export procedures
14. Market survey of food processing industries
15. Food safety measures followed in food processing firms
16. Food safety regulations - Value addition - Minimization of wastage
17. AEZ in India – Floriculture

## **REFERENCE BOOKS**

1. Kota Sreenivasa Murthy and Himachalam Dasaraju, 2007, Food Processing in India, Lambert Academic Publications, New Delhi.
2. Modern Technology of Food Processing & Agro Based Industries (2<sup>nd</sup> Edition 2010), NIIR Publications, New Delhi.
3. Profitable Agro Based Project, 2005, NIIR Publications, New Delhi.
4. Sharma D.D., 2005, Total Quality Management, Sultan Chand & Sons, New Delhi.

## **MEL 448 CYBER EXTENSION (2+1)**

### **OBJECTIVES**

- To learn the basic concepts and definitions of cyber extension, its scope and importance.
- To learn the advanced developments in the field of communication and its applicability in agricultural extension.
- To have an access to the recent developments in the area of agricultural communication like E-mail, Internet, E-journals, e-choupal, digital library etc.

### **THEORY**

#### **Unit I: Introduction to cyber extension**

Cyber extension - definition - importance and scope - role of cyber extension in agricultural development - advantages and limitations of cyber extension

#### **Unit II: internet techniques:**

World Wide Web (WWW) - Internet and search engines types and uses web search strategies - major subject directories - developing websites - E-mail - Telnet - File Transfer Protocol (FTP).

#### **Unit III: success stories on information projects:**

Agriportal - Informatics network - *e choupal* - warana wired village project - ikisan project - MSSRF information village project - Information Kiosks.

#### **Unit IV: communication shops and websites**

Communication shops - digital library - information technology centers – Database - E-journals - Websites for agricultural development

#### **Unit V: information marketing:**

Information marketing - Success stories - Online consultancy - Agriculture Knowledge networking system - cyber laws.

#### **PRACTICALS**

Use of internet – E-mail- search engines – Telnet – multimedia module development – data bases – e-journals – video conferencing – on line services - creation of websites - networking - visit to cyber extension centers - study of information marketing.

#### **THEORY LECTURE SCHEDULE**

1. Cyber extension-Introduction - concepts and definitions
2. Scope and importance of cyber extension
3. Role of cyber extension in agricultural development
4. Applicability of cyber extension in transfer of technology
5. Advantages and limitations of cyber extension
6. World Wide Web (WWW) – meaning and importance
7. Internet – meaning – Internet in agricultural extension
8. Search engines – types and uses
9. Search tools – various kinds and uses
10. Subject directories – kinds and type
11. Websites - various kinds of websites on agriculture and transfer of technology
12. E-mail-meaning, principles and applicability
13. Telnet-meaning and descriptions
14. File transfer protocols-meaning and its application
15. Strategies followed on web search and down loading
16. Agriportal – meaning and application
- 17. Mid semester Examination**
18. Information network-concepts, principles and use
19. E-choupal-meaning principles and application
20. Warana wired village project-objectives and impact
21. i Kisan project-objectives, scope and importance
22. MSSRF information village project-objectives and impact
23. Information kiosk-definition and application
24. Communication shops-meaning, principles and applicability
25. Digital library-meaning principles and functions
26. Data bases-bibliographic and non-bibliographic data bases and advantages
27. E-journals – meaning and availability of various E-journals and procedural details
28. Information marketing-meaning, principle and application
29. Success stories in information marketing
30. On-line consultancy services – meaning - principle and availability in various fields
31. Agriculture knowledge networking systems – applicability, advantages and limitations
32. Cyber laws-meaning
33. Various kinds of laws on cyber extension
34. Applications of cyber laws - practical difficulties

#### **PRACTICAL SCHEDULE**

1. Practice in searching and downloading of information through internet
2. Access to various kinds of available websites on agriculture and rural development
3. Creation of website on agricultural communication
4. Brain storming session on applicability of internets in transfer of technology
5. Visit to MSSRF Village Resource Centre (VRC)
6. Access to e-mail-exchange of messages,
7. Access to multimedia
8. Creation of multimedia modules
9. Access to data bases
10. Access to e-journals, availability in Internet
11. Visit to digital library
12. Access to various virtual extension services
13. Techniques of marketing the agricultural products through telnet
14. Access to video conferencing through telnet

15. Access to various on-line consultancy services
16. Access to global agriculture knowledge network
17. Access to various CD-ROMS on agriculture

## REFERENCES

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2. Saravanan, R. 2010. ICTs for Agricultural Extension. New India Publishing Agency, New Delhi.
3. Srinivasan, K 2002. Agri portal - A powerful tool for transfer of technology In: Uthamasany et al. (Eds). New Dimensions in Transfer of Technology - Director of Extension Education TNAU, Coimbatore.
4. Swanson, S.E, Bentz, R.P. and A.J.Sofranko, 2003. Improving Agricultural Extension - A Reference Manual, FAO, Rome.
5. Uma Joshi, 2005. Information Communication Technologies for Development and Women Empowerment. Dominant Publishers and distributors, New Delhi.

## **MEL 449 GOVERNMENT POLICIES AND PROGRAMMES RELATED TO AGRICULTURE (1+1)**

### OBJECTIVES

To create the awareness on the objectives of the Government's price policy for agricultural produce and it aims at ensuring remunerative prices to the growers for their produce with a view to encourage higher investment and production.

### THEORY

#### **Unit I: Agricultural Crop Development Programmes**

Programmes – Definition , Concept – History of Agricultural Development Programmes – Integrated Cereals Development Programme (ICDP) – Development of Pulses – Oil seed production programme – Intensive Cotton Development Programme (ICDP) – Procurement and Distribution of paddy and millet seeds – Seed processing units – Vermi composting of Agricultural waste and organic farming programmes.

#### **Unit II: Agricultural Technology and Environmental Programmes**

Crop Insurance scheme – watershed – IAMWARM - mechanization scheme – Reclamation of Alkali soil – Drip and Sprinkler Irrigation scheme – Integrated scheme for oil seeds, pulses, oil palm and maize (ISOPOM) – Demonstration of System of Rice Intensification (SRI) techniques scheme – Food security policy.

#### **Unit III: Horticultural and Area Development Programmes**

National Horticulture mission – Agricultural labour welfare board schemes – Agricultural Innovative Programme – Hill Area Development Programme (HADP) – Western Ghat Development Programme (WGDP) – Holistic village Adoption scheme – Dry land Development programmes – SHG's and NGO's in Agricultural Development

#### **Unit IV: Agricultural Policy**

Policy – Definition, Concept – History of Agricultural policy, 2000 – Government role in promotion of increasing investment in agriculture – Poverty reduction – Food security – Environmental protection and land management – Organic farming.

#### **Unit V: Specific Agricultural Policy**

Agricultural price policy – Agricultural credit policy - marketing policy – Agricultural Research and Education Policy – Cooperative policy - Trade Policy – Agricultural Labour and Human Resource Policy – Agricultural Export-Import Policy – Dairy, Poultry and Fishery Policy – Processing and Post Harvest Policy

### PRACTICAL

Pros and Cons Agricultural Development Programmes after 1947 – Food security and Poverty Reduction schemes – Organic Farming and Environmental Management – Dry land Development Programmes and Hill area Development Programmes – National Horticulture Mission – Visit to waste shed – IAMWARM project scheme – Crop insurance scheme – (SRI Scheme) Visit to SRI field – (Agricultural Price Policy) Visit to Regulated Market – (Agricultural Credit & Marketing Policy) Visit to Cooperative Marketing Society – (Agricultural Research & Education Policy) - Visit to NGO – Agricultural Import and Export Policy (Visit to EXIM Bank) – Policy related to Supplementary Enterprises – Dairy, Poultry and Fishery (Visit to Fish farm) – Visit to Agricultural Processing Units (Post harvesting policy and processing) – Visit to APEDA and MPEDA – Visit to Commercial Bank – Visit to SHG (Poverty Reduction).

## **THEORY SCHEDULE**

1. Programmes – Definition , Concept - History of Agricultural Development Programmes
2. Integrated Cereals Development Programme (ICDP) - Development of Pulses – Oil seed production programme – Intensive Cotton Development Programme (ICDP)
3. Procurement and Distribution of paddy and millet seeds – Seed processing units - Vermi composing of Agricultural waste and organic farming.
4. Crop Insurance scheme - Agricultural watershed – IAMWARM - mechanization scheme
5. Reclamation of Alkali soil – Drip and Sprinkler Irrigation scheme - Integrated scheme for oil seeds, pulses, oil palm and maize (ISOPOM)
6. Demonstration of System of Rice Intensification (SRI) techniques scheme. - National Horticulture mission
7. Agricultural labour welfare board schemes - Agricultural Innovative Programme – Hill Area Development Programme (HADP) – Western Ghat Development Programme (WGDP)
8. Food security policy – poverty reduction - Holistic village Adoption scheme – Dry land Development programmes – SHG's and NGO's in Agricultural Development
- 9. Mid-Semester Exam**
10. Policy – Definition, Concept – History of Agricultural policy – 2000 - Government role in promotion of increasing investment in agriculture
11. Poverty reduction – Food security - Environmental protection and land management – Organic farming.
12. Agricultural price policy - Agricultural credit and marketing policy
13. Agricultural Research and Education Policy - Agricultural Cooperative and Trade Policy
14. Agricultural Labour and Human Resource Policy
15. Agricultural Export-Import Policy
16. Dairy, Poultry and Fishery Policy
17. Processing and Post Harvest Policy

## **PRACTICAL SCHEDULE**

1. Pros and Cons Agricultural Development Programmes after 1947
2. Food security and Poverty Reduction schemes
3. Organic Farming and Environmental Management
4. Dry land Development Programmes and Hill area Development Programmes
5. National Horticulture Mission
6. Crop insurance scheme
7. (SRI Scheme) Visit to SRI field
8. (Agricultural Price Policy) Visit to Regulated Market
9. (Agricultural Credit & Marketing Policy) Visit to Cooperative marketing society
10. (Agricultural Research & Education Policy) Visit to NGO
11. Agricultural Import and Export Policy (Visit to EXIM Bank)
12. Food security policy
13. Visit to BDO office to review the policies
14. Visit to Agri office
15. Visit to ADA office
16. Recent Government policy
17. Recent Government policy

## **REFERENCES**

1. [www.agricultural government policies.com](http://www.agricultural government policies.com)

## **MEL 450 VIDEO PRODUCTION (1+1)**

### **OBJECTIVES**

- To learn about video production in agriculture
- To know about the techniques of video recording and editing
- To gain experience on photography and video production

### **THEORY**

#### **Unit I: SCOPE AND IMPORTANCE OF VIDEO PROGRAMME:**

Video Production - introduction - video as a tool in communication. Video production in agriculture - Significance of Video Production in transfer of technology - Scope and importance in agricultural extension. Limitations of video in agricultural communication.

**Unit II: PHOTOGRAPHY:**

Photography techniques - types of video cameras - various parts of video camera - types of CDs - Digital video

**Unit III: PROCEDURE OF VIDEO PROGRAMME:**

Selection of messages - Preparation of script for video programmes - various formats. Straight talks, folk songs, debate, panel etc. Camera angles.

**Unit IV: TECHNIQUES OF RECORDING AND EDITING:**

Techniques of video recording, selection of location, selection of artists – Editing- Different types of lights and lighting requirements for video production.

**Unit V: VIDEO PRODUCTION FACILITIES AND RESEARCH STUDIES**

Success stories - video production facilities - video libraries, participatory video - Recent research studies in video production technology for technology transfer in agriculture.

**PRACTICALS**

Photography - practising the art of photography and developing skills - Selection of theme for video production - Identification of location - Selection of artists - Script writing - Selection and finalizing visuals - Video production and Adding titles - Production of Video Programme in Agriculture.

**THEORY LECTURE SCHEDULE**

1. Video production-introduction and importance , Video production in agriculture
2. Significance of video production in transfer of technology
3. Scope and importance of video communication in agricultural extension, Limitations of video in agricultural communication
4. Types of cameras and films
5. Photography techniques
6. Qualities of a good photograph, tips for taking good photographs - mistakes and their corrections
7. Types and Parts of the video camera and their functions
8. Compact Discs, Digital video techniques,
9. Mid semester Examination
10. Selection of messages for video production, Preparation of script for video programmes.
11. Format of video programme-straight talks, folk songs, Debates and panel discussion
12. Different camera angles, Techniques of Video Recording, Selection of location, selection of artists
13. Editing of recorded programme
14. Different types of Lights, Lighting requirements for Video Production
15. Success stories
16. Video production facilities, Video libraries, Participatory Video
17. Recent research studies in video production technology for transfer of technology in Agriculture

**PRACTICAL SCHEDULE**

1. Practising the art of photography
2. Developing skills in photography
3. Identification of mistakes in photography and their rectification
4. Selection of theme for video production
5. Identification of location
6. Selection of artists
7. Script writing for video programme
8. Script writing for video programme
9. Selection and finalising the visuals
10. Visit to digital video center
11. Video production – shooting
12. Video production – shooting
13. Adding titles
14. Recording
15. Editing
16. Production of video programme in agriculture
17. Production of video programme in agriculture

**REFERENCES**

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2. John, K. 2000. Television and Social Change in Rural India. Sage Publications., New Delhi.

3. Singh, B.B, Amardeep, Ansari, M.A., Kameshwari, V.L.V and A.K. Singh. 2007. Instructional Technology and Multi-media Production for Agricultural Sciences, Agro-tech Publishing Academy, Udaipur.
4. Waghmore, S.K. 1996. Audio-Visual Education. Metropolitan Book Co.Pvt. Ltd., New Delhi.
5. White, S. A. 2003. Participatory Video. Sage Publications, New Delhi.

## **MODULE VII**

### **MEL 451 CLIMATE CHANGE AND BIO DIVERSITY MANAGEMENT (2+1)**

#### **OBJECTIVE**

Basic understanding of the impact of climate change on the farm front and strategies to manage agro-bio diversity thereof

#### **THEORY**

##### **Unit I: Climate change**

Climate change-causes and impact of climatic changes on agriculture-mitigation strategies-climate resilient farming- biosecurity in the context of climate change-disaster mitigation.

##### **Unit II: Dry land farming and drought**

Dryland farming and rainfed farming - Significance of dry farming in India- Major crops of Dry land in India and Tamil Nadu - Characteristics – constraints-Drought – Definition - Types and effects of Drought on crop production - Drought management - Contingent crop planning – Mid season correction – Mulching – anti-transpirants - Soil moisture conservation techniques and approaches - Water harvesting, storage and recycling - Integrated dry land technologies – Mechanization - Watershed management

##### **Unit-III: Importance of forest and its classification**

Forest definition- Role of forests-Status of forests- global forest scenario- Status and classification of Indian forests - National forest policy— Role of forests- Forest management – concepts – forest menstruation - felling and conservation.

##### **Unit-IV:**

Social Forestry- concept- Definition- Classification- Objectives Joint Forest Management (JFM) – Agroforestry- Definition- concepts- Benefits- Constraints – Criteria for selection of tree species for Agroforestry- Silviculture – definition – principles and practices – classification – Benefits

##### **Unit-V: Biodiversity and its conservation**

Introduction – Definition : genetic, species and ecosystem diversity - Biogeographical classification of India - Value of biodiversity : consumptive use, productive use, social, ethical, aesthetic and - option values - Biodiversity at global, National and local levels- India as a mega-diversity nation - Hot-spots of biodiversity- Threats to biodiversity : habitat loss, poaching of wildlife, man-wildlife conflicts- Conservation of biodiversity : In-situ and Ex-situ conservation of biodiversity.

#### **PRACTICAL**

Study of drought management technologies in dryland agriculture – Preparation of contingency crop plan for aberrant rainfall situations – Visit to watershed area to study the impact of various soil and moisture conservation methods. Nursery layout – Nursery technologies of important species – Clonal propagation – Volume estimation Felling and transportation -Visit to forest plantation and forest depot - Hot-spots of biodiversity-Conservation of biodiversity.

#### **THEORY LECTURE SCHEDULE**

1. Climate change- causes
2. Impact of climatic changes on agriculture-
3. Mitigation strategies
4. Climate resilient farming
5. Biosecurity in the context of climate change-disaster mitigation.
6. Dryland farming and rainfed farming - Significance of dry farming in India
7. Major crops of Dry land in India and Tamil Nadu - Characteristics – constraints
8. Drought – Definition - Types and effects of Drought on crop production
9. Drought management - Contingent crop planning
10. Mid season correction – Mulching – anti-transpirants
11. Soil moisture conservation techniques and approaches
12. Water harvesting, storage and recycling
13. Integrated dry land technologies – Mechanization
14. Watershed management
15. Forests – definition – status of Forests, Global, National and state

16. Components of forests – forests classification based on – age – regeneration – composition management – ownership – growing stock.
17. Status and classification of Indian forests - National forest policy
- 18. Mid-Term Examinations**
19. Role of forests- Forest management – concepts.
20. Forest menstruation - felling and conservation.
21. Social Forestry- concept- Definition- Classification.
22. Objectives Joint Forest Management (JFM)
23. Agroforestry- Definition- concepts.
24. Benefits- Constraints – Criteria for selection of tree species for Agroforestry.
25. Silviculture – definition – concepts and objectives.
26. Silviculture- principles and practices – importance – classification – models and benefits of silviculture.
27. Biodiversity -Introduction – Definition : genetic, species and ecosystem diversity.
28. Value of biodiversity
29. Consumptive use, productive use, social, ethical, aesthetic and - option values –
30. Biodiversity at global, National and local levels- India as a mega-diversity nation –
31. Hot-spots of biodiversity-
32. Threats to biodiversity : habitat loss, poaching of wildlife, man-wildlife conflicts-
33. Conservation of biodiversity :
34. In-situ and Ex-situ conservation of biodiversity.

### **PRACTICAL SCHEDULE**

1. Climate change- mitigation strategies
2. Disaster mitigation
3. Mapping of Arid and semiarid region of World and India
4. Rainfall analysis and crop planning
5. Study of dryland farming system
6. Preparation of cropping scheme for different dry farming situations
7. Demonstration of mulching and seed coating
8. Demonstration of spraying of antitranspirants and growth retardants
9. Acquiring skills in landshaping methods for insitu moisture conservation
10. Drought management technologies in dryland agriculture - Preparation of contingency crop plan for aberrant rainfall situations
11. Identification and description of seeds and seedlings of important silviculture tree species.
12. Nursery methods for important silviculture tree species – Mother bed – raised bed and sunken bed.
13. Production of seedlings for woodlots – Avenue plantation and calculation of timber volume – using formulation
14. Working out economics of important silviculture tree species
15. Visit to forest plantation and forest timber depot.
16. Biodiversity conservation
- 17. Final Practical Examination**

### **REFERNCES**

1. Fakhri and Wim Sombroek.1996. Global climate change and Agriculture production. FAO and John Wiley & Sons, Newyork.
2. Climate change and bio diversity. 2008. Institute of chartered financial analyst of India.

## **MEL 452 AGRICULTURAL PROJECT MANAGEMENT (2+0)**

### **OBJECTIVES**

The objective of this course is to provide knowledge to the students on project selection, formulation, financial feasibility analysis, monitoring and evaluation techniques with special reference to agricultural sector.

### **THEORY**

#### **Unit I: Introduction to Project Management**

Project – definition - characteristics - project cycle - classification, identification – formulation. feasibility study - economic and market analysis - environmental impact study - financial analysis - risk and uncertainty - project appraisal - detailed project report.

#### **Unit II: Organizational Project Management**

Project Organization design - human resource management - role management - team building – communication – motivation - decision – making leadership.

### **Unit III: Project Management Techniques**

Project management - bar chart - milestone chart – networks - PERT - network diagram - Computation of EST & LST - network revision - Time-Cost relationship of an activity project crashing - Project Control.

### **Unit – IV: Monitoring**

Monitoring – introduction – basic elements – importance - monitoring and progress reporting – monitoring techniques - indicators for monitoring -Types of monitoring - monitoring risk uncertainties

### **Unit – V: Evaluation**

Evaluation – definition - introduction – features – importance - comparison of appraisal, monitoring and evaluation - types of evaluation -designing monitoring and evaluation system- salient aspects of evaluation-quantitative and qualitative approaches- participatory monitoring and evaluation-social audit-evaluation report

## **THEORY LECTURE SCHEDULE**

1. Introduction - project definition
2. Project characteristics – project performance dimensions
3. Project life cycle – conceptualization – planning – execution phases
4. Project classification
5. Project Identification – formulation.
6. Feasibility study - economic and market analysis - environmental impact study
7. Financial Analysis – Pay back Period – ROI – NPV - IRR
8. Risk and Uncertainty – economic benefit – management aspects
9. Project appraisal – market – technical – economic appraisal
10. Detailed project report
11. Project organization design
12. Human resource management - role management
13. Team building – communication
14. Motivation - decision – making leadership.
15. Project management - bar chart - milestone chart
16. Networks - PERT - Network Diagram
- 17 **Mid-Semester Examination**
18. Computation of EST & LST - network revision
19. Time-Cost Relationship of an activity
20. Project crashing - project control.
21. Monitoring – introduction – basic elements - importance
22. Monitoring and progress reporting – monitoring techniques
23. Indicators for monitoring
24. Types of monitoring
25. Monitoring risk uncertainties
26. Evaluation – definition - introduction – features – importance
27. Comparison of appraisal, monitoring and evaluation
28. Types of evaluation
29. Designing monitoring and evaluation system
30. Salient aspects of evaluation
31. Quantitative and qualitative approaches
32. Participatory monitoring and Evaluation
33. Social audit
34. Evaluation report

## **REFERENCE BOOKS**

1. Chalmers, James, 2002. *How to Manage Project*, Jaico Publishing House, Mumbai.
2. Chandra, Prasanna, 1995. *Projects: Preparation, Appraisal, Budgeting and Implementation*, Tata McGraw Hill Publications, New Delhi.
3. Gittinger, Price J., 1982. *Economic Analysis of Agricultural Projects*, The John Hopkins University Press, London.
4. Goel, B.B., 1989. *Project Management*, Deep & Deep Publications, New Delhi.
5. Little I.M.D., and J.A. Mirlees, 1974. *Project Appraisal and Planning for Developing Countries*, Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi.



## MEL 453 EMERGING TRENDS IN PEST AND DISEASE MANAGEMENT ( 1+1)

### OBJECTIVE

To Study the novel approaches and recent developments in pest and disease management.

### THEORY

#### Unit I: Botanicals in Insect Pest Management

Insecticides of plant origin, Plant molecules as cue for novel insecticides. Improved extraction methods of insecticides of plant origin against Traditional methods viz., Arkam, Cold infusion, Asavam, Ksharam, Kashayam and Phaandam. Characterization of secondary plant compounds. Synthesis of secondary plant compounds.

#### Unit II: Novel actions and Improved Formulations of insecticides

Novel actions of insecticides - Antifeedant, Ovipositional deterrent, Repellent and Insect growth regulatory actions. Improved formulations of insecticides. Nano technology in formulation.

#### Unit III: Biotechnology in insect pest management

Genetic improvement of natural enemies – mass production and in vitro production of entomopathogens in cell lines – genetic engineering with baculoviruses - transgenic plants with BT toxin genes – assessing risks and benefits of transgenic crops

#### Unit IV – Biotechnological approaches for plant disease management

Biotechnological tools – Tissue culture – Protoplast fusion – Meristem tip culture –Gene cloning – Genetic engineering etc.- Transgenic plants in crop protection – Molecular and Biochemical diagnostics – Improving antagonistic potential of biological agents through genetic engineering

#### Unit – V – Integrated Disease Management

Third generation fungicides – Plant products in disease management – Role of inorganic nutrients and resistance inducing chemicals in disease management - Conventional disease management strategies –Perspectives of using natural products in plant disease management

### PRACTICAL

Identification of plants of insecticidal value – Neem, Pungam, *Vitex*, *Acorus*, *Ocimum*, Garlic, Onion, Turmeric, *Adathoda* etc. Extraction procedures, Techniques in isolation of secondary plant compounds – Instrumentation in characterization of secondary plant compounds. Bioassays to study mode of action of natural products. Identification of improved formulations of insecticides. Procedure in Cell line culture of NPV – Study of impact of bioinoculants on insect incidence.

Tissue culture techniques - Diagnostic tests for identification of diseases - Genetic engineering .Formulation of biological agents - Preparation of natural / animal products formulations - Testing antimicrobial properties of natural products - Biochemical changes as induced by natural products / chemicals - Practical Examinations

### THEORY LECTURE SCHEDULE

1. Insecticides of plant origin, Current Status of botanicals in pest management.
2. Improved Extraction methods of insecticides of plant origin against Traditional methods - Arkam, Cold infusion, Asavam, Ksharam, Kashayam, Phaandam.
3. Characterization of secondary plant compounds.
4. Synthesis of secondary plant compounds.
5. Novel actions of insecticides - Antifeedant, Ovipositional deterrent, Repellent and Insect growth regulatory actions.
6. Improved formulations of insecticides. Nano technology in formulation.
7. Genetic improvement of natural enemies – mass production and in vitro production of entomopathogens in cell lines – genetic engineering with baculoviruses.
8. Transgenic plants with BT toxin genes – assessing risks and benefits of transgenic crops
9. **Mid semester examination.**
10. . Biotechnological tools
11. Tissue culture, Protoplast fusion & Meristem tip culture
12. Gene cloning – Genetic engineering
13. Transgenic plants in crop protection, Molecular and Biochemical diagnostics, Improving antagonistic potential of biological agents through genetic engineering
14. Third generation fungicides
15. Plant products and animal products in disease management
16. Role of inorganic nutrients and resistance inducing chemicals in disease management
17. Conventional disease management strategies and Perspectives of using natural products in plant disease management

## **PRACTICAL SCHEDULE**

1. Identification of plants of insecticidal value.
2. Sample collection procedures, Preparation of plants for extraction.
3. Practicing Soxhlet method of extraction, solvent method of extraction at room temperature, practicing water extraction method.
4. Acquainting traditional methods of extraction.
5. Bio- assay for anti-feedant and Repellent study.
6. Bio- assay for insecticidal and IGR study.
7. Identification of improved formulations of insecticides.
8. Cell line culture of NPV and impact of bioinoculants on insect incidence
9. Tissue culture techniques
10. Diagnostic tests for identification of diseases
11. Genetic engineering
12. Formulation of biological agents
13. Preparation of natural / animal products formulations
14. Testing antimicrobial properties of natural products
15. Biochemical changes as induced by natural products
16. Biochemical changes as induced by chemicals
- 17. Practical examination**

## **REFERENCE BOOKS**

1. Agnes M. Rimando, Stephen O. Duke. 2006. Natural Products for Pest Management. American Chemical Society, USA. 927p.
2. Dodia, D. A., I. S. Patel and G. M. Patel 2008. Botanical pesticides for pest management. Scientific Publishers, Jodhpur. 354 p.
3. Dubey N K, 2011. Natural Products in Plant Pest Management. CAB International, USA. .312 p.
4. Shahid Ahmad, Udit Narain (2007). Eco friendly Management of Plant Diseases. Daya publishing house. ISBN PB : 8170354854, 477pp.
5. Punja, Z.K., Boer, S.De., Sanfacon, H.I. 2007. Biotechnology and Plant Disease Management, CABI, UK, 580 pages

## **MEL 454 GERMPLASM CONSERVATION (1 + 1)**

### **OBJECTIVES**

- To understand the origin and diversity of important crops and the importance of the conservation
- To understand on patent systems and international agreements on Agriculture
- To understand the classification of varieties using descriptors and utilizing germplasm in breeding programmes.

### **THEORY**

#### **Unit – 1 : Origin of species, and diversity conservation**

Plant Genetic Resources (PGR) and their importance - Agrobiodiversity and Centres of origin - Primary and secondary centres – PGR base for reconstruction and reconstellation of new cultivars.

#### **Unit – 2 : Collection of Germplasm and Conservation**

Collection- Patterns of variation and genetic makeup - sample size and collecting efficiency - Collection records: field and laboratory - Entering the collected material into the gene bank - Handling the site data - Conservation: Relation of in situ conservation to nature conservation and agricultural production

#### **Unit – 3 : Characterization and Documentation of Germplasm**

Documentation: initial data verification and reorganization - passport data - tasks of the documentation - requirements for documentation - Characterization: taxonomic - using plant descriptors - biochemical: using isozymes and DNA markers

#### **Unit – 4 : Evaluation of Germplasm and Crop Genetic Network**

Evaluation: primary and secondary evaluations - National and Regional PGR centres - Intellectual Property Rights (IPR) and PGR - Plant Breeders rights – Farmers rights – PGR in strengthening Plant Breeding research system - Central data bases and their features - The core collection concept - PGR management - conventional and recent approaches - molecular markers in germplasm management - tracing the pedigree - identifying the duplicates - Utilization - types of collection

#### **Unit – 5 : Patent Systems and Regulatory Bodies**

PGR exchange - national and international formalities - Plant quarantine check – Implications of World Trade Organisations (WTO), General Agreement on Trade and Tariff (GATT), Trade Related

Intellectual Property Rights (TRIPs), Plant Variety Protection (PVP) and Convention on Biological Diversity (CBD) on PGR

## **PRACTICAL**

Methodologies for germplasm conservation - Exploration and collection: understanding the distribution, ecology, botany and genetic makeup of each crop species - Route map - Collection: sample size and collecting efficiency - Collection records: field and laboratory - Entering the collected material into the gene bank - Handling the site data - Conservation: ex situ conservation (long term and medium term repositories) - In situ conservation of germplasm: various approaches - Documentation: initial data verification and reorganization - passport data - requirements for documentation - data processing and information supply - Characterization: taxonomic - using plant descriptors - biochemical: using isozymes and DNA markers - Evaluation: primary and secondary evaluations - Crop Genetic Resources Network: International and National - Role of International Agricultural Research Centres (IARCs) in PGR conservation - National and Regional PGR centres visit - Intellectual Property Rights (IPR) and PGR - Plant Breeders rights - Farmers rights - PGR in strengthening Plant Breeding research system - Central data bases and their features - The core collection concept - PGR management - conventional and recent approaches - molecular markers in germplasm management - tracing the pedigree - identifying the duplicates - Utilization - types of collection - PGR exchange - national and international formalities - Plant quarantine check.

## **LECTURE SCHEDULE**

1. Plant Genetic Resources (PGR) and their importance- Agrobiodiversity and Centres of origin
2. PGR: base for reconstruction and re-constellation of new cultivars
3. Collection: Patterns of variation and genetic makeup
4. Sample size and collecting efficiency.
5. Collection records: field and laboratory
6. Entering the collected material into the gene bank , Handling the site data.
7. Mid Semester Examination
8. Documentation: initial data verification and reorganization
9. Passport data - tasks of the documentation - requirements for documentation
10. Biochemical: using isozymes and DNA markers
11. Evaluation: primary and secondary evaluations
12. National and Regional PGR centres - Intellectual Property Rights (IPR)
13. PGR - Plant Breeders rights - Farmers rights- PGR in strengthening Plant Breeding research system - Central data bases and their features
14. The core collection concept - PGR management - conventional and recent approaches
15. Molecular markers in germplasm management - tracing the pedigree identifying the duplicates
16. Utilization types of collection - PGR exchange - national and international formalities- Plant quarantine check
17. Implications of World Trade Organizations (WTO), General Agreement on Trade and Tariff (GATT), Trade Related Intellectual Property Rights (TRIPs)- Plant Variety Protection (PVP) and Convention on Biological Diversity (CBD) on PGR

## **PRACTICAL SCHEDULE**

1. Methodologies for germplasm conservation
2. Exploration and collection: understanding the distribution, ecology, botany and genetic makeup of each crop species
3. Collection: sample size and collecting efficiency interference of new cultivars - Collection records: field and laboratory - Entering the collected material into the gene bank
4. Handling the site data
5. Conservation: ex situ conservation (long term and medium term repositories)
6. In situ conservation of germplasm: various approaches
7. Documentation: initial data verification and reorganization - passport data - requirements for documentation
8. Data processing and information supply
9. Characterization: taxonomic - using plant descriptors
10. Biochemical: using isozymes and DNA markers
11. Evaluation: primary and secondary evaluations
12. Crop Genetic Resources Network: International and National - Role of International Agricultural Research Centres (IARCs) in PGR conservation
13. National and Regional PGR centres
14. Intellectual Property Rights (IPR) and PGR - Plant Breeders rights - Farmers rights - PGR in strengthening Plant Breeding research system

15. Central data bases and their features - The core collection concept - PGR management - conventional and recent approaches
16. Molecular markers in germplasm management - tracing the pedigree - identifying the duplicates
17. Utilization - types of collection - PGR exchange - national and international formalities - Plant quarantine check

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## MEL 455 MANAGEMENT OF COMMERCIAL ORCHARDS (1+1)

### OBJECTIVES

This course deals with the planning, establishment, maintenance, harvest, post-harvest packing , pricing , cost economics and budgeting of commercial orchards.

### THEORY

#### Unit I: Planning and Execution of an Orchard

Introduction –Site Analysis and selection –Orchard Planning- – Soil and Water analysis - Land preparation-Season of planting - Selection of Nursery stock – Planting Systems - Orchard lay Out – Soil hybridization Techniques -- Soil Sterilization Planting Techniques- Staking.

#### Unit II: Crop Management Practices

Irrigation management- Canopy management practices- Training, & pruning- Floor management - Inter-cultivation practices - green manures, vegetable and flower crops – Weed management- Pest and Disease management – Crop regulation practices- Senile Orchard management – Rejuvenation pruning – Top working.

#### Unit III: Orchard tools& implements and post harvest Management.

Orchard Tools and Implement-Requirement, Usage, Maintenance – Machinery for major operations like Spraying, Harvesting, Pruning etc.-Maturity indices – Harvesting –Post harvest management practices- Packing- Storage-Transportation- Cold chain management.

#### Unit IV Farm planning

Importance – characteristics of good farm plan – farm planning procedure – Budgeting: definition and types – complete budgeting – partial budgeting – enterprise budgeting – cash flow budgeting – limitations of budgeting

#### Unit V Farm Records

Farm recors and accounts – analysis of farm records and accounts – balance sheet – income statement – cash flow statement

### THEORY LECTURE SCHEDULE

1. Introduction –Site Analysis and selection, Orchard Planning, Soil and Water analysis and Land preparation- Orchard lay Out
2. Season of planting - Selection of Nursery stock
3. Planting Systems - Soil hybridization Techniques - Soil Sterilization
4. Planting Techniques- Staking- Irrigation management
5. Crop management practices- Training, & pruning
6. Floor management - Inter-cultivation practices - green manures, vegetable and flower crops – Weed management
7. Pest and Disease Management.
8. Crop regulation practices- Senile Orchard management – Rejuvenation pruning – Top working

9. Orchard Tools and Implement-Requirement, Usage, Maintenance – Machinery for major operations like Spraying, Harvesting, Pruning etc.,
10. Mid-Semester Maturity indices – Harvesting –Post harvest management practices- Packing- Storage-Transportation- Cold chain management.
11. Maturity indices – Harvesting –Post harvest management practices- Packing- Storage- Transportation- Cold chain management.
12. Importance – characteristics of good farm plan – farm planning procedure
13. Budgeting: definition and types
14. Complete budgeting – partial budgeting – enterprise budgeting – cash flow budgeting – limitations of budgeting
15. Farm recors and accounts – analysis of farm records and accounts
16. Balance sheet – income statement
17. Cash flow statement

## **PRACTICALS**

Site Analysis and selection –Orchard Planning- Land preparation - Pit making – Planting medium preparation - Soil Hybridization- Selection of Nursery stock – Planting Systems - Orchard lay out – Soil Sterilization - Planting Techniques- Staking- Training, & pruning- Training, & pruning - Orchard Tools and Implement-Requirement, Usage, Maintenance. Problems on factor-product relationship- determination of least-cost combination- determination of optimum product combination-computation of cost concepts- cost of cultivation and cost of production of agricultural crops, horticultural and livestock products - preparation of complete and partial budgets - preparation of farm plan – graphical solution to linear programming problem.

## **PRACTICAL SCHEDULE**

1. Site Analysis and selection –Orchard Planning-
2. Land preparation - Pit making –
3. Planting medium preparation - Soil Hybridization-
4. Selection of Nursery stock –
5. Planting Systems - Orchard lay out – Soil Sterilization –
6. Planting Techniques- Staking-
7. Training, & pruning- Training, & pruning –
8. Orchard Tools and Implement-Requirement, Usage, Maintenance.
9. Visit To commercial orchards
10. Problems on factor-product relationship-
11. Computation of cost concepts
12. Determination of least-cost combination
13. Determination of optimum product combination
14. Cost of cultivation and cost of production of agricultural crops
15. Cost of cultivation and cost of production of horticultural crops
16. Cost of cultivation and cost of production of livestock products
17. Preparation of complete and partial budgets - preparation of farm plan – graphical
18. Solution to linear programming problem.

## **MEL 456 SOIL, WATER, PLANT- HEALTH AND MANAGEMENT ( 1 + 1)**

### **OBJECTIVES**

The main objectives of this course is to impart practical knowledge on soil related constraints, irrigation water quality appraisal guidelines and their efficient management, diagnosis of plant nutrient related problems and role of microbes on soil , water and plant health management.

### **THEORY**

#### **Unit I. Soil related constraints and their management**

Soil related constraints in crop production – physical, chemical and biological constraints – Identification, extent, causes and measures to combat the constraints

#### **Unit II : Irrigation water quality appraisal and its management**

Irrigation water – ground water – Characteristics, problems due to use of poor quality water – water quality quidelines – Management of poor quality water.

#### **Unit III: Diagnostic Techniques for nutrient disorders**

Diagnosis of nutrient related problems in crop plants – Deficiency and Toxicity. Diagnostic key for identifying nutrient deficiency – plant sampling for diagnosis of nutritional disorders – Tissue analysis and total analysis – Differentiating criteria for nutrient deficiency symptoms from insects and disease attack – Prescription – DRIS – Interpretation of plant analytical results.

#### **Unit-IV: Microorganisms on soil management**

Role of microbes as bio inoculants in Agriculture, Types of Biofertilizers and mass production, Inoculant for bio composting, Method of biocompost production, biogas production, Mass production of Cyanobacteria.

#### **Unit- V: Plant microbe interaction**

Mycorrhiza – ecto and endomycorrhiza – AM fungi – distribution and importance – PGPR organisms – Plant growth regulators and phytotoxin production by microorganisms – use of soil microorganisms for pest and disease control – Biopesticides and mass production.

#### **PRACTICALS**

Identification of physical and chemical constraints – Techniques for reclamation of acid, sodic and saline soils. Methods of fertilizer application for different crops. Assessing nutrient efficiency in problem soils. Analysis of irrigation water for its quality and interpretation. Diagnosis of crop plant for nutrient deficiency, toxicity and physiological disorders. Plant tissue tests.

Isolation of symbiotic N<sub>2</sub> fixing microorganisms, Isolation of phosphate solubilizing microorganisms, Mass production and quality control of biofertilizers, Assessment of VAM fungi colonization in crop plants, Mass production of VAM fungi, Aerobic method of composting of organic wastes, Production of biogas from agricultural wastes and Mass production of Cyanobacteria.

#### **THEORY LECTURE SCHEDULE**

1. Soil constraints – extent and types
2. Physical constraints – identification, types and causes
3. Management of soil physical constraints
4. Chemical constraints – Identification, types, causes
5. Management of chemical constraints
6. Irrigation water characteristics and problem arising due to poor quality water
7. Water quality guidelines and their management
8. **Mid Semester Examination**
9. Diagnosis key for identifying nutrient deficiency and toxicity
10. Plant sampling for diagnosing nutrient disorders for field crops and horticultural crops
11. and Interpretation and reporting of results of plant analysis
12. Role of microbes as bioinoculants in Agriculture, Types of Biofertilizers and mass production.
13. Inoculant for biocomposting, Method of biocompost production, biogas production.
14. Biogas production.
15. Mass production of Cyanobacteria.
16. Mycorrhiza – ecto and endomycorrhiza – AM fungi – distribution and importance.
17. Plant growth regulators and phytotoxin production by microorganisms.
18. Use of soil microorganisms for pest and disease control – Biopesticides and mass production.

#### **PRACTICAL SCHEDULE**

1. Key to identify physical constraints ( Soil aggregate analysis, Shear strength)
2. Key to identify chemical constraints ( pH, EC, ESP, SAR, CaCO<sub>3</sub>)
3. Techniques for reclamation of acid soil ( Lime requirement)
4. Techniques for reclamation of saline soil ( Lime requirement)
5. Techniques for reclamation of sodic soil (Gypsum requirement)
6. Interpretation of irrigation water quality ( pH, EC, SAR, RSC, Potential salinity and potential alkalinity hazard )
7. Assessing nutrient efficiency for enhanced productivity in problem soils
8. Diagnosis of plant nutrient deficiency and toxicity symptoms
9. Quick test / Tissue test for plant nutrient status and prescription
10. Isolation of symbiotic N<sub>2</sub> fixing microorganisms and phosphate solubilizing microorganisms.
11. Mass production and quality control of biofertilizers.
12. Assessment of VAM fungi colonization in crop plants.
13. Mass production of VAM fungi.
14. Aerobic method of composting of organic wastes.
15. Production of biogas from agricultural wastes.
16. Mass production of Cyanobacteria.
17. Practical Examination

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