LECTURE OUTLINES

B.Sc. (Hons.) Horticulture

2024

Dr.Y.S.R. Horticultural University

Venkataramannagudem,
West Godavari (Dist) – 534101
Andhra Pradesh

Dr. K.Gopal
Vice-Chancellor

FOREWORD

The Dr. Y.S.R. Horticultural Universit, Venkataramannagudem,Tadepalligudem of Andhra Pradesh established during the year 2007 is mandated with development of skilled human resource in the field of Horticulture through education,research and extension.It primarily focuses on imparting quality education through its five constitiuent and four affiliated colleges.

The National Education Policy -2020 has reformed the education system in India including higher agricultural education.The continuous updating of course curricula based on recent technological advancement ensures that students know about the cutting edge technologies in Horticulture. Soon after the announcement of the NEP-2020, ICAR has constituted the Sixth Dean committee to update and revise the undergraduate course curriculum, course content, degree nomenclature including entry-exit options recommending the reforms in amission including lateral entry options and examinations. The committee had updated the course curriculum as per the guidelines of NEP 2020 focussing skill enhancement with integration of digital learning with focus on better employability, flexibility in learning, multiple entry and exit option, experiential learning, entrepreneurship and innovative teaching approaches.

Consequently Dr YSR Horticultural University has implemented VI Deans committee recommendations given by ICAR from 2024-25 academic year onwards in all colleges offering undergraduate programme and revised the syllabus and guidelines

I immensely appreciate the efforts of Dr.L.Naram Naidu, Dean of Horticulture,All university officers,Associate Deans along with the faculty who have contributed to align,update and contextualise the lecture outlines-2024 as per recommendations of VI Deans committee in tune with NEP-2020 for the first time for UG programme which will help the UG students and teachers of the University.

I hope the revision made in the UG syllabus reenergizes the Horticulture education system and help the students to hone their horticultural skills.

(K.GOPAL)

Dr.L.NARAM NAIDU
Dean of Horticulture &
Nodal officer (ICAR)

ACKNOWLEDGEMENT

It is my pleasure to express deep sense of gratitude to Dr.K.Gopal, Hon'ble Vice-Chancellor for the constant encouragement, guidance and tremendous support in revising the syllabus of undergraduate programme as per VI Deans Committee recommendations in line with NEP2020.

The help rendered by Dr.B.Prasannakumar, Controller of Examinations, Dr.S.Surya Kumari Dean of Student Affairs ,Dr.K.T.V.Ramana,Dean of PG studies,Dr.M.Madhavi, Director of Research, Dr.B.Govindarajulu, Director of Extension ,Dr.K.Ramanandam, University Librarian and Dr.S.S.Vijayapadma Director,PME cell Dr.YSRHU is here by acknowledged.

Thanks are also due to Dr.A.V.D.DorajeeRao, Associate Dean, COH, Venkataramannagudem, Dr.P.T.Srinivas, Associate, Dean, COH, Anantharajupeta, Dr.R.Rajyalakshmi, Associate Dean, COH, Parvathipuram, Dr. V. Vijaya Bhaskar, Associate Dean, COH, Chinalataripi and Dr.R.Nagaraju Associate Dean, COH, Pulivendula is acknowledged. The assistance extended by all the Teachers in the Colleges of Horticulture of various departments is acknowledged. The co-ordination extended by Dr.T.S.K.K.Kiran Patro, Technical Officer to Dean of Horticulture in preparation, edition and compilation of Lecture Outlines Manuscript is acknowledged.

(L.NARAM NAIDU)

Contents

Semester wise distribution of
B.Sc.(Hons.)Horticulture degree course curriculum

I semester

S. No.	Course No.	Course Title	Course Credits
		Deeeksharambh	2(0+2) NG
1	FRMJ1.1.1	Fundamentals of Horticulture	3(2+1)
2	FRMJ1.1.2	Plant Propagation and Nursery Management of Fruit and Plantation crops	3(1+2)
3	FLMJ1.3.1	Commercial production of Flower crops	**3(2+1)**
4	ESMD1.11.1	Farming Based Livelihood Systems	3(2+1)
5	HEMN1.12.1	Sprinkler and Micro irrigation systems	2(1+1)
6	ENMJ1.6.1	Fundamentals of Entomology and nematology	2(1+1)
7	ESAE1.11.1	Communication Skills	2(1+1)
8		Skill Enhancement Courses (SEC – I)	2(0+2)
9		Skill Enhancement Courses (SEC – II)	2(0+2)
10	NSAE 1.0.1	NSS-I	1(0+1)
		Total	**23** (10+13) **+ NG 2** (0+2)

II semester

S. No.	Course No.	Course Title	Course Credits
1	ASMN1.9.1	Introduction to major field crops	3(2+1)
2	SPMJ1.4.1	Commercial production of spices and plantation crops	3(2+1)
3	ASMJ1.9.1	Weed and water management in horticultural crops	2(1+1)
4	ESAE1.11.2	Personality Development	2(1+1)
5	ESMD1.11.2	Entrepreneurship Development and Business Management	3(2+1)
6	HEVA1.12.1	Environmental Studies and Disaster Management	3(2+1)
7	PTMJ1.7.1	Principles of IPDM	1(0+1)
8		Skill Enhancement Courses (SEC- I)	2(0+2)
9		Skill Enhancement Courses (SEC-II)	2(0+2)
10	NSAE 1.0.2	NSS-II	1(0+1)
		Total	**22** (10+12)
		Post II semester	
		Internship (only for exit option for award of UG-Certificate) includes Production of fruits and vegetables etc.	**10**(0+10) 10 weeks

SKILL ENHANCMENT COURSES

	Course No.	SEC-I (any of two courses can be selected)	Course Credits
1	PTSE-1.7.1	Mushroom Cultivation	2(0+2)
2	ENSE-1.6.1	Apiculture, Sericulture & Lac Culture	2(0+2)
3	FRSE-1.1.1	Orchard Floor Management	2(0+2)
4	SPSE-1.4.1	Value addition of Spice, Plantation, Medicinal and Aromatic crops	2(0+2)*

		SEC-II (any of two courses can be selected)	
1	FLSE-1.3.1	Landscape Gardening	2(0+2)
2	PHSE-1.5.1	Packing and Packaging of Horticultural crops	2(0+2)
3	HESE-1.12.1	Farm Machinery	2(0+2)
4	PTSE-1.7.2	Production technology of bio agents and bio pesticides	2(0+2)*

III semester

S. No.	Course No.	Course Title	Course Credits
1	ASMN 2.9.1	Fundamentals of Soil Science	3(2+1)
2	ASMN 2.9.2	Manures and fertilizers	2 (2+0)
3	VSMJ 2.2.1	Commercial vegetable production	4(3+1)
4	ASMN 2.9.3	Introductory Agro meteorology and Climate Change	2 (1+1)
5	VSMJ 2.2.2	Seed production of vegetable, tuber and spice crops.	3(2+1)
6	ESMD2.11.1	Agriculture Marketing and Trade	3(2+1)
7	PTMJ 2.7.1	Fundamentals of Plant Pathology	3(2+1)
8	ESNG2.11.1	Elementary Mathematics	1(0+1)NG
9	PHNG2.5.1	Fundamentals of food and nutrition	2 (2+0)NG
10		Skill Enhancement Courses (SEC – III)	2(0+2)
11	PYAE 2.0.1	Physical education, First aid, Yoga practices and Meditation	2(0+2)
		Total	**24** (14+10) + **3**(2+1) NG

IV semester

S. No.	Course No.	Course Title	Course Credits
1	FRMJ 2.1.1	Commercial fruit production	4 (3+1)
2	HEMJ 2.12.1	Farm Power and Machinery for Horticulture	3(2+1)
3	ESVA2.11.1	Agricultural informatics and Artificial intelligence	3(2+1)
4	FLMJ 2.3.1	Urban and Peri Urban Horticulture	2(1+1)
5	PTMJ 2.7.2	Disease Management of Horticulture crops	3(2+1)
6	ENMJ 2.6.1	Pest Management of Horticulture crops	3(2+1)
7	VSMJ 2.2.3	Precision farming and protected cultivation	2 (1+1)
8	SPMJ 2.4.1	Commercial production of medicinal and aromatic crops	2 (1+1)
9		Skill Enhancement Courses (SEC - IV)	2(0+2)
		Total	**24** (14+10)

SKILL ENHANCMENT COURSES

	Course No.	SEC-III (any of one course can be selected)	Course Credits
1	HESE 2.12.1	Maintenance of Micro-irrigation & Drone Technology in Horticulture	2(0+2)
2	FLSE 2.3.1	Turf and Turf Management	2(0+2)

3	FLSE 2.3.2	Computer Aided Designing	2(0+2)
4	ASSE 2.9.1	Management of Organic wastes(New Course Proposed)	2(0+2)

	Course No.	SEC-IV (any of one course can be selected)	Course Credits
1	FRSE 2.1.1	Nursery Production in Horticulture crops	2(0+2)
2	VSSE 2.2.1	Seed Production in vegetable and flower crops	2(0+2)
3	FLSE 2.3.3	Dry Flower Technology	2(0+2)
4	PHSE 2.5.1	Post Harvest management in horticultural produce	2(0+2)

V semester

S. No.	Course No.	Course Title	Course Credits
1	GPMN 3.8.1	Principles of genetics	2(2+0)
2	GPMN 3.8.2	Principles of biotechnology	2(1+1)
3	FRMJ 3.1.1	Dry land Horticulture	3(2+1)
4	PBMN 3.10.1	Introductory Crop Physiology	2(1+1)
5	ASMJ 3.9.1	Horticulture Based Integrated Farming System	2(1+1)
6	PBMN 3.10.2	General microbiology	3(2+1)
7	ASMN 3.9.1	Introductory Agro forestry	2(1+1)
8	ENMJ 3.6.1	Pests of field crops and their management	2(1+1)
9	ESMN 3.11.1	Basic Statistics and Experimental Designs	3(2+1)
10	VLAE-3.0.1	Veterinary Livestock Production and Management	1(0+1) NG
11	NG 3.0.1	Education Tour	2(0+2) NG
		Total	**22** (13+9) NG 2(0+2)

VI semester

S. No.	Course No.	Course Title	Course Credits
1	PHMJ 3.5.1	Processing and Value Addition of Horticultural Crops	3(2+1)
2	PBMJ 3.10.2	Laboratory Techniques for Horticultural crops	2(0+2) NG
3	PBMN 3.10.3	Principles of biochemistry	2(1+1)
4	ASMJ 3.9.2	Soil Fertility and Nutrient Management	3(2+1)
5	GPMN 3.8.3	Fundamentals of plant breeding	2 (1+1)
6	ASMN 3.9.2	Principles and Practices of Natural Farming	2(1+1)
7	ESMJ 3.11.1	Information and Communication Technology in Horticulture	3(1+2)
8	PBMJ 3.10.1	Growth and Development of Horticultural crops	3(2+1)
9	ESMN 3.11.2	Fundamentals of Extension Education and Rural Sociology	2(1+1)
10	PTMJ 3.7.1	Diseases of field crops and their management	2(1+1)
		Total	**23**(12+11) **+ NG 1**(0+1)

S. No.	Course No.	Course Title	Credit structure
1	FREL 4.1.1	Good Horticultural practices	2(1+1)
2	VSEL 4.2.1	Hi-tech Horticulture	2(1+1)
3	FLEL 4.3.1	Ornamental Horticulture and Landscaping,	3(2+1)
4	FLEL 4.3.2	Value addition in Flowers and Ornamentals	2(1+1)
5	PHEL 4.5.1	Post Harvest Management of Horticultural Crops	3(2+1)
6	ENEL 4.6.1	Horti-clinic	1(0+1)
7	ENEL 4.6.2	Agro Chemicals	2(1+1)
8	PTEL 4.7.1	Biological Control, Bio pesticides and Bio fertilizers	2(1+1)
9	GPEL 4.8.1	Breeding of Horticultural crops	3(2+1)
10	GPBL-4.8.2	Agricultural microbiology and Phyto remediation	2(1+1)
11	PBEL 4.10.1	Molecular Aspects of aboitic stress Management in Horticultural Crops- Newly Proposed	2(2+0)

VII Semester (Elective courses)

12	PBEL 4.10.2	Biotechnology and micropropagation for Crop Improvement	3(2+1)
13	ESEL 4.11.1	Agricultural finance and co-operation	2(1+1)
14	SPEL 4.4.1	Plant propagation in Nursery management in vegetables, Flowers and Medicinal Crops	3(1+2)
15	ESEL 4.11.2	Economics and Marketing	3(2+1)

VIII Semester Student READY(RHWEP+ELP)

S. No.	Course title	Credits
1.	RHWEP	10
2.	ELP	10
Total		20

Massive Open Online Courses (MOOCs)

MOOC3.0.1	2	MOOCs	10(0+10)	V semester
MOOC3.0.2	2	MOOCs		VI semester
MOOC4.0.1	3	MOOCs		VII semester
MOOC4.0.2	3	MOOCs		VIII semester

ABSTRACT

Core (Major+Minor)		
Major Courses	69	
Minor Courses	34	
	103	
Common Courses (MD, AE and VA)		
Multi Disciplinary	9	
Ability Enhancement	8	9
Value Addition	6	
	23	
Non Gradial Courses	**8***	**7***
Elective Courses	**20**	
Skill Enhancement Courses	**12**	
Student Ready (RHWEP+ELP)		
RHWEP	10	
ELP	10	
	20	
MOOC /Online	**10****	
	178+ 8*+ 10**	

*Non-Gradial ** Online courses

Deeksharambh (Introduction--cum foundation course) (0+2)

Duration: 2 Weeks

Course Objective: To provide a holistic introduction to university life, foster cultural integration, and instill life and social skills.

Lecture 1-4

Introduction to Deeksharambh & University Framework - Overview of academic processes and curriculum, Importance of cultural integration in a university setting, role of Deeksharambh in student development, student introductions, campus tour

Lecture 5-8:

Social Skills and Effective Communication - Importance of social skills in professional and personal life, components of effective communication (verbal and non-verbal), active listening and empathy, barriers to effective communication and how to overcome them. Learning to know and to do

Lecture 9-12:

Social Awareness and Cultural Sensitivity - Social responsibility and awareness, understanding the interplay of gender, race, class and other identities, understanding different cultural perspectives and backgrounds, traditional values and indigenous cultures in the context of horticulture, navigating cultural differences with respect and understanding. Gender sensitivity and equality, living together

Lecture 13-16:

Ethics and Values in Academic and Personal Life - Defining ethics and values, ethical dilemmas in environmental stewardship, core values: integrity, responsibility, and accountability, impact of personal values on teamwork and leadership, learning to be

Lecture 17-20:

Teamwork and Collaboration - The role of collaboration in academic and professional success, dynamics of effective teams: roles, leadership and conflict resolution, how teamwork contributes to innovation and creativity, teamwork in the context of project-based learning.

Lecture 21-24:

Leadership Skills for Emerging Professionals - Understanding leadership: characteristics and styles, Leadership in the context of environmental management, decision-making and problem-solving as leadership skills, inspiring others and motivating teams.

Lecture 25-28:

Fostering Creativity and Innovation - The role of creativity in problem-solving, cultivating a mindset of innovation and exploration, overcoming obstacles to creative thinking, case studies.

Lecture 29-32:

Reflections, Alumni Interactions and Future Directions - Open discussion on how to apply social skills, ethics, and teamwork in future academic and professional settings, interaction with successful alumni and professionals, setting personal goals for the upcoming academic journey.

Dr. YSR Horticultural University, Venkataramannagudem
B.Sc. (Hons) Horticulture

TIME TABLE FOR Deeksharambh I year I semester				
DAY	**MORNING**		**L**	**AFTER NOON**
	9.00-11.00 A.M	**11.00-1.00**		**2.00-4.00**
1	Session 1	Session 5	**L U N C H**	Session 9
2	Session 17			Session 13
3	Session 21	Session 25		Session 29
4	Session 2	Session 6		Session 10
5	Session 14	Session 18		Session 22
6	Session 26	Session 30		Session 3
7	Session 7	Session 11		Session 15
8	Session 19	Session 23		Session 27
9	Session 31	Session 4		Session 8
10	Session 12			Session 16
11	Session 20	Session 24		Session 28
12	Session 32			

Course No.	**Name of the teacher**
Session 1-4	OAM, UG Academic Assistance
Session 5-8	OSA
Session 9-12	Warden (Girls Hostel) & Senior Professors
Session 13-16	Senior Professors
Session 17-	Warden (Boys Hostel) & Senior Professors

20	
Session 21-24	Senior Professors
Session 25-28	Senior Professors
Session 29-32	Senior Professors

I SEMESTER COURSES

Course No : FRMJ - 1.1.1
Course Title : Fundamentals of Horticulture - 3 (2+1)

Lecture Outline:

Theory:

1. Scope and importance of horticultural crops in terms of economy, production, employment generation, environmental protection and human resource development
2. Area and production statistics, exports and imports of horticultural crops in India
3. Fruit and vegetable zones of India and of Andhra Pradesh.
4. Nutritive value of horticultural crops
5. Divisions of horticulture with suitable examples and their importance
6. Classification of horticultural crops based on climate, botanical relationship, type of fruit ripening behaviour, photo periodic requirements and salinity tolerance.
7. Classification of horticultural crops based on bearing habit
8. Nursery techniques of horticultural crops and their management
9. Soil and climate requirements of horticultural crops
10. Mulching– objectives, types merits and demerits
11. Vegetable gardens, nutrition and kitchen garden, truck garden, vegetable forcing, market garden and floating garden – principles, planning and layout
12. Orchard establishment- different steps followed in planning and layout of orchard
13. Different steps in establishment of an orchard
14. Management of orchards
15. Planting systems *i.e* square, rectangular, quincunx, hexagonal, contour terracing and planting densities
16. Calculation different planting densities in different systems of planting
17. Definition of training – Principles, objectives, methods of training in fruit crops-open cantered, central leader system and modified leader system; their merits and demerits
18. Principles, objectives, types and methods of pruning and training of fruit crops
19. Types and use of growth regulators in horticulture
20. Water management– Irrigation methods, i.e. Surface methods and drip, sprinkler systems merits and demerits
21. Weed management- definition of weed, different types of weeds and their management in horticulture crops
22. Fertility management in horticultural crops, manures and fertilizers, different methods of application
23. Cropping systems, intercropping, multi-tier cropping
24. Fruitfulness and unfruitfulness- Factors influencing the fruitfulness and unfruitfulness
25. Rejuvenation of old orchards, top working, frame working,
26. Organic farming-Concept, definition principles- advantages and components of organic farming
27. Natural farming-Concept, definition principles- advantages and components of natural farming
28. Maturity; definition of maturity, different methods followed for judging the maturity in horticulture crops
29. Post harvest operations in horticulture crops -harvesting, grading, packing and storage
30. Different storage methods of horticulture crops

31. Market chain management of horticulture crops
32. Export opportunities in horticulture crops

Practicals:

1. Study of features of orchard, planning and layout of orchard
2. Study of tools and implements in horticulture
3. Identification of various horticultural crops
4. Layout of nutrition garden
5. Preparation of nursery beds for sowing of vegetable/ flower seeds
6. Digging of pits for fruit plants
7. Layouts of different planting systems
8. Study of different methods of training systems
9. Study of different methods of pruning of orchard trees
10. Calculation of fertilizer doses, Preparation of fertilizer mixtures and field application
11. Calculation, preparation and application of growth regulators
12. Layout of different irrigation systems
13. Identification and management of nutritional disorder in fruits and vegetable crops,
14. Study of bearing habits in horticulture crops
15. Study of Maturity standards and harvesting of important fruits, vegetables and flowers
16. Study of grading, packaging and storage of important fruits, vegetables and flowers .

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Course No : FRMJ - 1.1.2
Course Title : Plant Propagation and Nursery Management of fruit and plantation crops 3(1+2)

Lecture Outline:

Theory:

1. Definition, Status and importance of plant propagation and nursery production in fruits , plantation crops and other annuals.
2. Sexual and asexual methods of propagation (Apomixis, chimeras), their advantages and disadvantages.
3. Seed germination, Seed dormancy, types of dormancy and methods to overcome seed dormancy.
4. Vegetative propagation methods viz. Division-corm, rhizome, bulbs, tubers- by separation,- runners, stolons, suckers, pseudo bulbs, bulbils, offsets, cloves, slips, crowns and tubercles.
5. Propagation by cutting-A) stem cuttings: i) hardwood cuttings- simple cutting, mallet cutting, limb cutting, heel cutting ii) semi hard wood cutting iii) soft wood cutting iv) herbaceous cuttings B) leaf cuttings C) Root cuttings . Factors influencing rooting of cutting

6. Propagation by layering-types of layering A) ground layering: i) simple layering ii) tip layering iii)compound layering iv) trench layering V) mound layering B) Air layering C) herbaceous layering. Physiological and bio chemical basis for rooting in cutting and layering
7. Methods of budding: T-budding, inverted T-budding, I-budding, Patch budding, Chip budding, Ring budding, flute budding, forket budding. Anatomical studies of bud union
8. Grafting methods –advantages and disadvantages. A) Approach method of grafting B) Detached method of grafting i) veneer grafting ii) whip/tongue grafting, Iv) saddle grafting. Special techniques of grafting – softwood grafting, epicotyl grafting, herbaceous grafting, root grafting, crown grafting, bridge grafting and double working. Formation of graft union- graft incompatibility symptoms and types.
9. Propagation structures in nursery production: Mist chamber, humidifiers, greenhouses, glasshouses, cold frames, hot beds, poly-houses and phytotron.
10. Use of growth regulators in nursery production.
11. Components of a nursery, growing medium and containers used for nursery production.
12. Maintenance of mother trees and seed gardens, collection of scion-wood and bud wood certification.
13. Role of tissue culture techniques viz. micro propagation, micro grafting and meristem culture.
14. Nursery registration act.
15. Management of insect-pests and diseases in nursery.
16. Cost of establishment of a modern nursery. Crop specific plant propagation practices in horticultural crops of commercial importance.

Practicals:

1. Selection of site, soil sterilization
2. Preparation of nursery beds and nursery raising.
3. Media characteristics and preparation of growing media
4. Use of different nursery containers for Horticultural crops.
5. Selection of mother trees and seed gardens, collection of scion-wood for grafting
6. Seed treatments for breaking dormancy and prevention of nursery diseases.
7. Sowing of seed, raising and maintenance of rootstock/ seedlings.
8. Practicing different vegetative propagation methods Cuttage
9. Practicing different vegetative propagation methods Layerage
10. Practicing different vegetative propagation methods Graftage
11. Practicing different vegetative propagation methods Buddage
12. Potting, repotting and maintenance of houseplants.
13. Practices in manuring, drip and fertigation, foliar nutrition,
14. Practices in pinching, disbudding, staking.
15. Crop-specific plant propagation practices in mango, jack fruit, cashew and custard apple
16. Crop-specific plant propagation practices in sweet orange, jamun, grapes, and guava
17. Crop-specific plant propagation practices in fig, phalsa, dragon fruit and pine apple
18. Crop-specific plant propagation practices in banana
19. Crop-specific plant propagation practices in vegetables
20. Crop-specific plant propagation practices in flowers
21. Hardening of plants in nursery
22. Visit to local nurseries and florist centres.
23. Marketing requirements and strategies for sale of planning material
24. Calculation and Preparation of plant growth regulators for seed germination and vegetative propagation.
25. Digging, labelling and packing of field grown nursery plants.
26. Familiarisation with propagation structures such as mist chamber, greenhouse, glasshouse, poly house, net house and their maintenance.
27. Micro propagation and hardening of plants.
28. Tissue culture-Media preparation, explant preparation, in vitro culturing and shoot tip culture, primary and secondary hardening of tissue culture plants.
29. Maintenance of nursery records.
30. Identification and management of insect-pests and diseases in nursery.
31. Project formulation for small and high-tech nurseries.

32. Nursery Accreditation.

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Course No : FLMJ - 1.3.1
Course Title : Commercial production of Flower crops 3(2+1)

Lecture Outline:

Theory:

1. Scope and importance of flower cultivation in India. Present status, future prospects and strategies needed for improvement. Area, production and exports.
2. Rose: Introduction, origin and distribution, classification, species and varieties, climate, soil requirements, propagation – Rootstocks, Stock scion compatibility, land preparation, planting
3. Manures and fertilizers, cultural operations (pruning, pinching and mulching) use of growth regulators, physiological disorders, harvesting and yield in open and protected conditions-post harvest management and rose bi-products.
4. Gerbera: Introduction, origin and distribution, classification, species and varieties, climate and soil requirements, propagation, land preparation, planting
5. Manures and fertilizers, cultural operations, defoliation, soil loosening, shading, use of growth regulators, physiological disorders, harvesting, post harvest management and yield.
6. Orchids: Introduction, origin and distribution, classification, species and varieties, climate and growing media requirements, propagation, orchidarium construction, planting
7. Manures and fertilizers, cultural operations, physiological disorders, use of growth regulators, harvesting, post harvest management and yield.
8. Carnation: Introduction, origin and distribution, classification, species and varieties, climate and soil requirements, propagation, land preparation, planting
9. Manures and fertilizers, cultural operations, (pinching and disbudding) use of growth regulators, physiological disorders, harvesting, post harvest management and yield.
10. Anthurium: Introduction, origin and distribution, classification, species and varieties, climate and shade requirements, growing media, propagation, systems of growing, planting

11. Fertigation, cultural operations, de-suckering, defoliation, use of growth regulators, physiological disorders, harvesting, grades, post harvest management and yield.
12. Gladiolus: Introduction, origin and distribution, classification of varieties, species and varieties, climate and soil requirements, propagation, land preparation, planting
13. Manures and fertilizers, cultural operations, use of growth regulators, physiological disorders, harvesting, post harvest management and yield.
14. Jasmine : Introduction, origin and distribution, classification of varieties, species and varieties, climate and soil requirements, propagation, land preparation, planting
15. Manures and fertilizers, cultural operations, use of growth regulators, physiological disorders, harvesting, post harvest management and yield.
16. Marigold: Introduction, origin and distribution, species and varieties, F_1 Hybrids, climate and soil requirements, propagation, land preparation, planting
17. Manures and fertilizers, cultural operations, (pinching and disbudding) use of growth regulators, harvesting, post harvest management and yield.
18. Chrysanthemum: Introduction, origin and distribution, classification, species and varieties, climate, importance of artificial lighting and soil requirements, propagation, land preparation, planting
19. Manures and fertilizers, cultural operations, (pinching and disbudding) use of growth regulators, harvesting, post harvest management and yield.
20. Tuberose: Introduction, origin and distribution, classification, species and varieties, climate and soil requirements, propagation, land preparation, planting
21. Manures and fertilizers, cultural operations, use of growth regulators, harvesting, post harvest management and yield.
22. Dahlia: Introduction, origin and distribution, classification, species and varieties, climate and soil requirements, propagation, land preparation, planting. Manures and fertilizers, cultural operations, (pinching and disbudding) use of growth regulators, harvesting, post harvest management and yield.
23. China aster: Introduction, origin and distribution, classification, species and varieties, climate and soil requirements, propagation, land preparation, planting
24. Manures and fertilizers, cultural operations, (pinching and disbudding) use of growth regulators, harvesting, post harvest management and yield.
25. Crossandra: Introduction, origin and distribution, species and varieties, climate and soil requirements, propagation, land preparation, planting
26. Manures and fertilizers, cultural operations, use of growth regulators, harvesting, post harvest management and yield.
27. Bird of paradise: Introduction, origin and distribution, classification, species and varieties, climate and soil requirements, propagation, land preparation, planting. Manures and fertilizers, cultural operations, use of growth regulators, harvesting, post harvest management and yield.
28. Filler crops- Introduction, origin and distribution, classification, species and varieties, climate and soil requirements, propagation, land preparation, planting. Manures and fertilizers, cultural operations, use of growth regulators, harvesting, post harvest management and yield of Golden rod, Gypsophila, Limonium.
29. Cut Foliages: Introduction, Global scenario of cut foliages, scope of cut foliages in India, identification of different types of cut foliages
30. Cut Foliages: Climate, Preparation of soil, Planting, Propagation, seeds, Cuttings, layering, After care, Irrigation, weeding, Pruning, Shadenet management
31. Growing of flowers under protected environments such as glass house, plastic house etc. Rose, Orchids, Anthurium, Carnation, Gerbera and cut flower type Chrysanthemums- special climatic conditions
32. Post harvest technology of cut flowers – causes for deterioration of cut flower quality – Food depletion – Bacterial and fungal infections – Maturation and ageing – Wilting – Bruising – Temperature – Ethylene – Water – Factors affecting cut flower longevity – Handling – Harvest stage – Grading and Bunching – Packaging – Precooling – Storage– Floral preservatives viz., (Pulsing solution – Bud opening solution – Vase solution –Conditioning) – Cold storage.

Practicals:

1. Identification of important flower crops and their varieties
2. Propagation of rose by cutting and budding
3. Propagation methods in chrysanthemum
4. Propagation methods for Jasmine
5. Preparation of nursery bed for sowing of flower seeds.
6. Soil decontamination techniques and bed preparation
7. Training and Pruning of Roses in open and polyhouse.
8. Special horticultural practices in Chrysanthemum and jasmine
9. Horticultural practices like Pinching, netting and wiring for Carnation under protected cultivation.
10. Study on drip irrigation, misting and Fertigation of flower crops under protected conditions.
11. Study on the influence of PGR's on important flower crops
12. Identification of important fillers and foliage plants.
13. Visit to green house to study protected cultivation of Gerbera & orchids
14. Visit to green house to study protected cultivation of Rose & Chrysanthemums.
15. Field visit to commercial flower growing area
16. Post harvest handling operations followed in flower crops

References:

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- Randhawa, G.S. Amitabha Mukhopadhyay, 2004. Floriculture in India. Allied Publishers Pvt. Ltd:
- Arora, J.S. 2006. Introductory Ornamental Horticulture. Kalyani Publishers, Ludhiana - 141 008.
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Course No : ESMD - 1.11.1
Course Title : Farming Based Livelihood Systems 3 (2+1)

Lecture Outline:

Theory

1. Status of agriculture in India and different states, Income of farmers and rural people in India
2. Livelihood-Definition, concept and livelihood pattern in urban & rural areas
3. Different indicators to study livelihood systems
4. Agricultural livelihood systems (ALS): Meaning, approach and framework
5. Definition of farming systems and farming based livelihood systems.
6. Prevalent Farming systems in India contributing to livelihood, Types of traditional & modern farming systems

7 - 8 Components of farming system/ farming-based livelihood systems- Crops and cropping systems

9 - 10 Livestock (Dairy, Piggery)

11-12. Livestock (Goatry, Poultry, Duckry etc.),

13. Horticultural crops based systems

14. Agro-forestry systems

15-16 Aqua culture- Duck/Poultry cum Fish, Dairy cum Fish, Piggery cum Fish etc.,

17. Small & medium enterprises as livelihood components for farmers

18 -19 Large enterprises including value chains and secondary enterprises as livelihood components for farmers

20. Factors affecting integration of various enterprises of farming for livelihood.

21-22 Feasibility of different farming systems for different agro-climatic zones

23 -24 Commercial farming-based livelihood models by NABARD, ICAR and other organizations across the country

25 - 26 Case studies on different livelihood enterprises associated with the farming.

27 Risk & success factors in farming-based livelihood systems

28 Schemes & programmes by Central & State Government involved in promotion of farming-based livelihood opportunities.

29 Public & Private organizations involved in promotion of farming-based livelihood opportunities

30 Role of farming-based livelihood enterprises in 21st Century in view of circular economy and green economy

31 Role of farming-based livelihood enterprises in 21st Century in view of Climate change

32 Role of farming-based livelihood enterprises in 21st Century in view of digitalization & changing life style.

Practical

1 Survey of farming systems and agricultural based livelihood enterprises

2 - 3 Study of components of important farming based livelihood models/ systems in different agro-climatic zones

4 Study of production and profitability of crop based livelihood models

5 Study of production and profitability of livestock based livelihood models

6 Study of production and profitability of processing based livelihood models

7 Study of production and profitability of integrated farming based livelihood models

8 Field visit to innovative farming system models

9 - 10 Study of agri-enterprises involved in industry and service sectors (Value Chain Models)

11 Visit to Agri-based enterprises

12 Functional aspects of Agri-based enterprises for integration of production, processing & distribution sectors

13 Learning about concept of project formulation on farming-based livelihood systems

14 Cost & profit analysis of farming-based livelihood systems

15 Case study of Start-Ups in agri-sectors (Case study –I)

16 Case study of Start-Ups in agri-sectors (Case study –II)

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Course No : HEMN – 1.12.1
Course Title : Sprinkler and Micro irrigation systems 2 (1+1)

Lecture Outline:

Theory:

1. Sprinkler irrigation- Suitable crops and suitable soils, adaptability, advantages, problems and prospects.
2. Basic components of Sprinkler irrigation system - Sprinkler nozzle, twin nozzle, Selection of suitable nozzle size, recommended pressure and nozzle discharge rate.
3. Classification of Sprinkler Irrigation system- Classification based on different factors like method of water Application, Portability, Precipitation rate, Principle and operation movement
4. Design and layout of Sprinkler irrigation System- Hydraulic design of sprinkler system, water Spread area of Sprinkler, Index jet break up, Application rate of Sprinkler, Selection of Sprinkler, Sprinkler Spacing.
5. Design of lateral, design of sub-main and design of main pipeline and numerical problems. Pressure Requirement of the sprinkler System, Capacity of sprinkler system and layout of sprinkler system.
6. Selection of Pump, General rules for sprinkler irrigation system design and layout, model design of Sprinkler System.
7. Micro Sprinkler Irrigation system- Advantages, disadvantages, components, design of micro sprinkler irrigation system.
8. Determination of water requirement, Selection of sprinkler nozzle, layout, design of lateral, sub main, main line, selection of pump, calculation of irrigation time.
9. Model design of micro sprinkler irrigation system and cost estimation of micro sprinkler irrigation system, operation and maintenance of sprinkler irrigation system and trouble shooting
10. Drip irrigation system-Meaning, benefits, Limitations, Components, types of drip irrigation system, operational requirement, Measures for promotion of drip irrigation system.
11. Drippers/ Emitters- Basic requirement of dripper, types of dripper, Selection of emitters, Pressure-discharge relationship and characteristics of commonly available dripper.

12. Design of drip irrigation system-Basic information required, determination of water requirement and basic hydraulics of drip irrigation system, steps in designing of drip irrigation system.
13. Selection of dripper, design of lateral, sub main and main line, selection of pump and calculation of irrigation time.
14. Model design of drip irrigation system for one hectare vegetable crop and one hectare fruit crop
15. Installation and Commissioning of Drip Irrigation System, Installation of filter, Connecting main and Sub-mains, Laying of laterals, Punching of laterals and fixing of drippers, Installation of pump.
16. Maintenance of Drip Irrigation System- General Maintenance, Filter cleaning, sub mains and laterals flushing, Chemical Treatment.

Practical:

1. Study of different components of Sprinkler Irrigation System
2. Study of operation and maintenance of Sprinkler Irrigation System
3. Study of installation of Sprinkler Irrigation System
4. Study of different components of Micro-Sprinkler Irrigation System
5. Study of different types of micro Sprinkler Irrigation Systems
6. Study of Operation and Maintenance of Micro Sprinkler Irrigation System
7. Measurement of Uniformity Co-efficient of Sprinkler Irrigation System
8. Study of centrifugal pumping system
9. Study of different components of Drip Irrigation systems
10. Installation and Commissioning of Drip Irrigation systems
11. Study of operation and maintenance of Drip Irrigation System
13. Study of fertigation scheduling for different horticultural crops
14. Preparation of buffer solution and fertigation through drip Irrigation system
15. Uniformity of water application in drip irrigation systems
16. Field visit to Micro Irrigation Systems

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- Jack Keller and Ron. D. Bliesener 2012. Sprinkler and Trickle Irrigation. Springer, US.

Course No : ENMJ-1.6.1
Course Title : Fundamentals of Entomology and Nematology **2 (1+1)**

Lecture Outline:

Theory:

1. History and scope of entomology and economic importance, dominance of insects in animal kingdom of Class Insecta. Important characters of Phylum Arthropoda, relationship of Class Insecta with other arthropods.

2. Cuticle: Its structure and function, process of moulting. Body segmentation, head, thorax, abdomen and abdominal structure in insects. Types of insect head, sutures and sclerites of head, tentorium.
3. Types of insect mouth parts: Biting and chewing type, Piercing and sucking (bug type and mosquito type), Rasping and sucking type, Sponging type and Siphoning type.
4. Types of insect antenna-structure of typical antenna and its modifications . Types of insect Legs - Structure of a typical insect leg and modifications of insect legs. Wings: Venation, and types of insect wings, wing coupling mechanism.
5. Metamorphosis-Types of metamorphosis in insects and types of diapause, stage of occurrence of diapause with examples. Types of larvae and pupae – differences between nymph and larva.
6. Digestive system in insects: Foregut, mid gut and hind gut, filter chamber and process of digestion. Excretory system in insects, functions of Malphigian tubules. Circulatory system: Blood, Circulatory organs and process of circulation in insects.
7. Respiratory system: spiracles, tracheae and tracheoles, air sacs, mechanism of respiration. Classification of respiratory system. Endocrine System structure and functions. Nervous system: Different types of neurons, nerve impulse conduction. Structure of insect nervous system.
8. Insect Reproductive System: Female reproductive system-structure, different types of reproduction in insects. Male reproductive system – structure, physiology of sperm production, different types of reproduction in insects.
9. Introduction to new insect classification upto orders. Relationship of subphylum Hexapoda with other subphylums of phylum Arthropoda. Binomial nomenclature: Importance, history, International Code of Zoological Nomenclature, Law of Priority. Study of order characters of Orthoptera, Odonata, Isoptera, Dictyoptera, Neuroptera.
10. Study of order and family characters of Hemiptera (Pentatomide, Tingidae, Miridae) Homoptera (Cicadellidae, Aphididae, Coccidae, Aleurodidae, Pseudococcidae), Order Thysanoptera (Thrips), Order Hymenoptera (Tenthridinidae, Trichogrammatidae, Formicidae, Apidae, Ichneumonidae, Braconidae, Chalcididae)
11. Study of order and family characters of Lepidoptera: (Noctuidae, Sphingidae, Pyralidae, Hesperidae, Papilionidae, Erebidae, Gelechiidae, Cochlididae), Order Diptera (Cecidomyiidae, Trypetidae, Tachinidae, Agromyzidae).
12. Study of order and family characters of Coleoptera (Coccinellidae, Chrysomelidae, Cerambycidae, Curculionidae, Scarabaeidae, Apionidae,Buprestidae, Elateridae)
13. History and development of nematology - definition, economic importance. General characters of plant parasitic nematodes, morphology and biology
14. Classification of nematodes up to family level with emphasis on groups containing economically important genera. Classification of nematodes by habitat.
15. Symptomatology and control of important plant parasitic nematodes of fruits – (tropical, sub-tropical and temperate), vegetables, tubers, ornamental, spice and plantation crops.
16. Role of nematodes in plant disease complex and Integrated nematode management.

Practicals:

1. Methods of collection and preservation of insects including immature stages.
2. External features of grasshopper / Cockroach
3. Types of insect antennae and mouthparts.
4. Types of insect legs and wings.
5. Types of larvae and pupae
6. Dissection of digestive system in insects (Grasshopper)
7. Dissection of male and female reproductive systems in insects (Grasshopper)
8. Study of characteristics or orders Orthoptera, Odonata, Isoptera and Dictyoptera and their families.
9. Study of characteristics of orders Hemiptera and Thysanoptera and their families.
10. Study of characteristics of order Lepidoptera and its families.
11. Study of characteristics of order Coleoptera and Neuroptera and its families.
12. Study of characteristics of order Hymenoptera and Diptera and their families.
13. Methods of sampling and extraction of nematodes from soil and plant parts.
14. Killing and fixing of nematodes
15. Symptoms of damage by nematodes in vegetable and fruit crops
16. Symptoms of damage by nematodes in spices, plantation, flowers, ornamental crops

References:

- Chapman, R.F. 1981. The Insects: Structure and function. Edward Arnold (Publishers) Ltd, London, 919p.
- Imms' General Textbook of Entomology - O. W. Richards , R. G. Davies
- Gullan,P.J. and Cranston,P.S.2001.The insects-An outline of entomology, II edition, Chapman &

Hall, Madras, 491p.
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Course No : ESAE - 1.11.1
Course Title : Communication Skills 2 (1+1)
Lecture Outline:

Theory:

Structural and Functional Grammar:

1. Sentence structure and modifiers, Connecting words and verbals; phrases and clauses
2. Case: subjective case, possessive case; objective case
3. Correct usage of nouns, pronouns and antecedents, adjectives, adverbs and articles
4. Agreement of verb with the subject: tense, mood, voice
5. Writing effective sentences; Basic sentence faults

Communication Process:

6. Communication-definition, The magic of effective communication; Building self-esteem and overcoming fears
7. Concept, nature and significance of communication process- source, message, content, channels, receiver and response
8. Meaning, types-formal communication, informal or grapevine communication, down ward communication, upward communication, horizontal communication; and models of communication(Aristotle model, Shannon-Weaver model, Berlo's model, Schramm model, Rogers and shoe maker model, Leagan's model
9. Verbal and non-verbal communication- writing, speaking; body language, facial expressions, gestures and postures
10. Linguistic and non-linguistic barriers to communication and reasons behind communication gap/ miscommunication.

Basic Communication Skills:

11. Listening Skills-Purpose, types, barriers and improving techniques
12. Speaking Skills-Importance, tone, fluency, clarity, body language and content
13. Reading Skills- Importance, types, barriers, improving techniques
14. Writing Skills -Précis Writing /Abstracting/Summarizing
15. Style of technical communication- Curriculum vitae/resume writing;
16. Innovative methods to enhance vocabulary, analogy questions.

Practical:

1. Sentence structure and modifiers, Connecting words and verbals; phrases and clauses
2. Subjective case, possessive case and objective case
3. Correct usage of nouns, pronouns and antecedents, adjectives, adverbs and articles
4. Agreement of verb with the subject: tense, mood, voice
5. Writing effective sentences; Basic sentence faults
6. Listening and Note taking practice
7. Micro-presentations and Feedback on presentations
8. Impromptu Presentations: Feedback on presentations (Stage manners: grooming, body language, voice modulation, speed)
9. Public speaking exercises
10. Reading and comprehension practice (written and oral) of general articles & technical articles

11. Vocabulary building exercises
12. Exercise on Precis writing, summarizing and abstracting
13. Preparation of resume/ curriculum vitae and covering letters
14. Group discussion practice
15. Interview Technique (Mock interviews)
16. Organization of events (Anchoring, goals, decision making, planning, executing, time management, money management, results and feedback)

References:

- Brown Michele & Gyles Brandreth, 1994, How to Interview and be Interviewed. Sheldon Press, London.
- Carnegie Dale, 1997, The Quick and Easy Way to Effective Speaking. Pocket Books, NewYork.
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Course No : NSAE - 1.0.1
Course Title : National Service Scheme (NSS) 1 (0+1)

Lecture Outline:
Practical :

1. Introduction and Basic Components of NSS
2. Orientation: history, objectives, principles, symbol, badge; regular programs under NSS
3. Organizational structure of NSS, Code of conduct for NSS volunteers
4. NSS program activities.
5. Concept of regular activities, special camping, day camps, basis of adoption of village/slums, conducting survey, analyzing guiding financial patterns of scheme,
6. Understanding youth. Definition, profile, categories, issues and challenges of youth; and opportunities for youth who is agent of the social change.
7. Youth program/ schemes of GOI, coordination with different agencies and maintenance of diary.
8. Community mobilization. Mapping of community stakeholders, designing the message as per problems and their culture; identifying methods of mobilization involving youth-adult partnership.
9. Social harmony and national integration Indian history and culture
10. Role of youth in nation building, conflict resolution and peace- building.
11. Volunteerism and shramdaan.
12. Indian tradition of volunteerism, its need, importance, motivation, and constraints; shamadan as part of volunteerism
13. Observance of state festivals through NSS units.
14. Citizenship, constitution and human rights.
15. Basic features of constitution of India, fundamental rights and duties, human rights, consumer awareness and rights and rights to information.
16. Family and society. Concept of family, community (PRIs and other community-based organizations) and society.

SKILL ENHANCEMENT COURSES-I

Course No : PTSE-1.7.1
Course Title : Mushroom Cultivation 2 (0+2)

Lecture Outline:
Practicals:

1. Introduction to mushrooms, current status and scope of mushroom cultivation in India and Andhra Pradesh.
2. Acquaintance with mushroom biology.
3. Acquaintance with the laboratory equipment and tools used in mushroom cultivation.
4. Mushroom foraying - ethics, safety measures and basic requirements for mushroom foraying.
5. Mushroom foraying within the campus and nearby wild ecosystem.
6. Spawn production technology - Preparation of culture media for isolation of mushroom cultures.
7. Spawn production technology - Isolation and purification of mushroom cultures.
8. Spawn production technology - Maintenance of mother cultures and their preservation.
9. Spawn production technology -Preparation of mother spawn
10. Spawn production technology -Preparation of commercial spawn

11, 12 &13.Cultivation technology of Oyster mushrooms (*Pleurotus* sp.) - Preparation of substrate and bedding, spawn running, streaking and harvest.

14, 15, 16. Cultivation technology of milky mushrooms (*Calocybe indica*) - Preparation of substrate and bedding, spawn running, casing and harvest.

17. Exposure visit to commercial mushroom production unit.
18. Preparation of ready to grow mushroom kits.
19&20. Morphological identification of various mushrooms.
21. Management of waste derived from mushroom cultivation.
22. Acquaintance with the medicinal/functional mushrooms.
23& 24. Use and comparison of various substrates available for mushroom cultivation.
25.Button mushroom cultivation technology and Composting.
26.Study of mushrooms pests and their management.
27.Study of mushrooms diseases and their management.
28.Post-harvest handling and packing of mushrooms.
29. Methods of mushroom preservation.
30. Preparation of value-added products from mushrooms.
31. Economics of mushroom cultivation.
32. Exposure visit to mushroom processing unit.

Course No : ENSE-1.6.1
Course Title : Apiculture, Sericulture and Lac culture 2(0+2)
Lecture Outline:
Practicals:

1. Identification of different castes of Honey bees
2. Identification and study of important species of honey bees
3. Study of different stages of the life cycle of the honey bee
4. Identification of Queen cells, Drone cells & Brood
5. Demonstration of different equipments required for bee keeping
6. Study of different types and parts of the bee box.
7. Handling frames of bee colony
8. Division and uniting of bee colonies
9. Queen bee grafting technologies
10. Study of Seasonal management and colony maintenance of bees
11. Bee pasturage – Different species of pollen and nectar rich plants
12. Identification and study of pests of honey bees
13. Identification and study of diseases of honey bees.
14. Honey harvesting and processing
15. By-products of Bee hive
16. Species of Silkworms - Characteristic features of Mulberry Silkworm, Tasar Silkworm, Eri Silkworm and Muga Silkworm and their hosts
17. Study of life cycle of *Bombyx mori*- Morphology of egg, larva, pupa and adult of Bombyx mori.
18. Dissection and display of Silk glands of silk worm
19. Study of components of silkworm rearing units
20. Silkworm grainage technologies

21. Chawki rearing: Preparation; brushing and its methods, types of chawki rearing
22. Late age silkworm rearing: Methods, optimum environmental conditions, feeding quantity and frequency, methods of bed cleaning, spacing, moulting and care during moult.
23. Types of mountages, their advantages and disadvantages
24. Cocoon characters for marketing
25. Harvesting-Time of harvesting, sorting, storage/ preservation, packaging and transport of cocoons, leaf-cocoon ratio, maintenance of rearing records
26. Mulberry planting methods and package of practices and their pests and diseases
27. Studies of identification, biology and hosts of lac insect
28. Studies on different inoculation methods, harvesting and pests of Lac
29. Processing of lac
30. Value addition of lac and their industrial usage
31. Visit to Beekeeping unit
32. Visit to Sericulture and lac unit

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Course No : FRSE-1.1.1

Course Title : Orchard Floor Management (0+2)

Lecture Outline:

1. Planning for the lay out of orchard
2. Layout of different systems of orchard
3. Steps for the establishment orchard
4. Layout of fruit nutrition garden
5. Study of different types of orchards
6. Study of sod culture and sod mulch
7. Study of clean cultivation
8. Study of inter cropping in orchard
9. Study of Cover cropping in orchard with examples
10. Study of mixed cropping in orchard with examples
11. Study of different training systems in orchard
12. Study of wind breaks in orchard with examples and characteristics of wind breaks
13. Study of filler crops in orchard with examples and characteristics of filler plants
14. Study of organic and inorganic mulches
15. Study of moisture conservation methods
16. Use of different pre emergence herbicides and post emergence herbicides in orchard
17. Layout of various irrigation systems-Surface irrigation: Flood system, basin system, modified basin system, furrow method

18. Layout of Drip irrigation system.
19. Lay out of sprinkler irrigation system
20. Different methods of applicationof manure and fertilizers
21. Calculation of fertilizer doses, Preparation of fertilizer mixtures and field application
22. Use of organic manures, Biofertilizers, Green manuring and bioagents
23. Study of fertigation in orchards
24. Integrated Pest Management.
25. Integrated Disease Management.
26. Canopy management, types and manipulation
27. Rejuvenation of old orchards, top working, frame working
28. Study of pollination and pollinizer
29. Study of crop regulation practices in orchard
30. Study of different crop models in orchard
31. Study of plant growth regulators in orchard management
32. Visit to fruit orchards of Progressive growers

References:

- Chadha, T.R. 2011. A Textbook of Temperate Fruits. ICAR, New Delhi.
- Sharma, K. K. and Singh, N. P. 2011. Orchard and Soil Management, Daya Publishers, NewDelhi.
- Bal, J.S. 2020. Fruit Growing, Kalyani Publishers, Ludhiana.
- ICAR 2020. Handbook of Horticulture Vol. I & II.
- Palaniappan, S.P and Siva kumar .K 1996. Cropping Systems in Tropics
- B.C Mazumdar.2004 principles and methods of orchard establishment
- B.C Mazumdar.2004. orchard irrigation and soil management practices

Course No : SPSE - 1.4.1

Course Title : Value Addition of Spices, Plantation, Medicinal and Aromatic Crops 2(0+2)

Lecture Outline:

Practical:

1. Processing and value added products of Pepper
2. Processing and value added products of Pepper
3. Processing and value added products of Turmeric
4. Processing and value added products of Ginger
5. Processing and value added products of Tree spices
6. Processing and value added products of Cardamom
7. Processing of Seed spices
8. Processing and value added products of Vanilla
9. Grading, packaging and storage of Spices and spice products
10. Preparation of ground spice and mixtures
11. Methods of extraction of Essential oil through distillation
12. Value added products of Coconut
13. Value added products of Coconut
14. Value added products of Arecanut
15. Processing in Oil palm
16. Processing and value added products of Cashew
17. Primary processing of Cocoa
18. Value addition in Cocoa
19. Value added products of Palmyrah
20. Processing, grading, packing, storage and value added products of Coffee
21. Methods of extraction of crude drug from Medicinal plants
22. Methods of extraction of crude drug from Medicinal plants
23. Processing, packing, storage and value added products of Aloe
24. Post harvest handling of important Medicinal plants
25. Packing, storage and value added products of important Medicinal plants
26. Post harvest handling of important Aromatic plants
27. Value added products of Aromatic plants

28. Commercial products of SPMA in domestic markets and their composition
29. Visit to commercial processing unit of Spices
30. Visit to commercial processing unit of Plantation crops
31. Visit to commercial processing units of Medicinal plants
32. Visit to commercial processing unit of aromatics crops.

References:

- Pruthi J S 1998. Major Spices of India Crop Management and Post Harvest Technology ICAR. Krishi Anusandhan Bhavan, Pusa, New Delhi.
- Peter K V 2002. Plantation crops. National Book Trust India, New Delhi.
- Kumar N 2018. Introduction to spices plantation crops medicinal and aromatic plants. Oxford and IBH publishing Co. Pvt. Ltd, New Delhi.
- Farooqi .A.A.& Sreeramu.B.S.2001. Cultivation of Medicinal and Aromatic crops.Universities Press Private Ltd.,Hyderabad.

II SEMESTER COURSES

Course No : ASMN - 1.9.1
Course Title : Introduction to major field crops 3**(2+1)**

Lecture Outline :

A) Theory

1. Classification and distribution of field crops

2-3. Definitions and concept of multiple cropping, mixed cropping, intercropping, classification of intercropping, relay and alley cropping, sustainable agriculture

4-5. Rice – Introduction – origin – area and production – climate and soils – varieties and hybrids for A.P. – Rice nurseries – wet, dry, dapog and modified dapog, puddling – seeds and sowing – direct seeding and transplanting

6-7. Systems of rice cultivation – upland, low land, SRI and aerobic rice

8. Nutrient management (N, P, K, Zn, iron and bio-fertilizers) – steps for increasing fertilizer use efficiency in rice

9-10. Water management – methods of irrigation – submergence, flooding – weed management – crop rotations – harvesting – threshing – processing – parboiling - yield attributes and yield

11-12. Wheat – origin – area and production – wheat growing zones of India – climate and soils – varieties – tillage – seeds and seeding – nutrient, water and weed management – crop rotations – harvesting, threshing and processing – yield attributes and yield

13. Cultural practices for raising of Maize

14. Cultural practices for raising of Sorghum

15. Importance of pulses, Cultural practices for raising of Pigeon pea

16. Cultural practices for raising of Chick pea and cowpea

17. Cultural practices for raising of Black gram, Green gram

18. Importance of oil seeds, cultural practices for raising of Soybean

19. Cultural practices for raising of Ground nut

20. Cultural practices for raising of Rapeseed and Mustard

21. Cultural practices for raising of Gingelly

22. Cultural practices for raising of Sunflower

23. Cultural practices for raising of Safflower

24-25. Cultural practices for raising of Cotton - origin – area and production- types of cotton - climate and soils – varieties – seeds and sowing – topping and boll shedding – nutrient, water and weed management – harvesting – crop rotations – quality evaluation

26-27. Cultural practices for raising of Sugarcane: Seed material- methods of planting- blind hoeing- trash mulching, crop rotation- wrapping and propping, harvesting- ratoon crop management

28. Cultural practices for raising of Fodder crops: Bajra and oats

29. Cultural practices for raising of Napier and Stylo

30. Cultural practices for raising of Berseem and Lucerne

31-32 Principles and practices of green manuring and cultural practices for raising of Green manure crops – Daincha, Sunnhemp and Pillipesara

B) Practicals:

1. Allotment of individual field for land preparation and sowing of crop
2. Calculation of seed rate and plant population
3. Different methods of sowing
4. Thinning, weeding, gap filling and recording germination percentage
5. Identification of crops, crop seeds and fodder crops
6. Rhizobium inoculation and seed treatment
7. Calculation of fertilizer dose
8. Calculation of herbicide dose

9-10. Time and methods of fertilizer applications

11. Different methods of herbicide application
12. Preparation of cropping scheme to suit different farming systems
13. Harvesting of crops in individual fields
14. Participation in post harvest operations and recording yield
15. Estimation of crop yield
16. Calculation of Economics (Cost of cultivation, gross returns, net returns and B:C ratio)

References:

- Chidda Singh. 1983. Modern techniques of raising field crops. Oxford & IBH publishing Co., New Delhi
- Reddy, S.R. 2004. Agronomy of field crops. Kalyani publishers, Ludhiana
- Subhash Chandra Bose, M and Balakrishnan, V. 2001. Forage production. South Asian publishers, New Delhi
- Anonymous, 2023, Package of practices for kharif crops.
- Anonymous,2023, Package of practices for rabi crops.
- Singh Chidda, 2020, Modern techniques of raising field crops. Oxford and IBH Publication.
- Reddy T Y and Reddy G H S, 2020, Principles of Agronomy, Kalyani Publishers, Ludhiana

Course No : SPMJ-1.4.1
Course Title : Commercial Production of Spices and Plantation crops 3 (2+1)

Lecture Outline:

Theory:

1. History and development, scope and importance, present status, area and production, export potential of spice crops and role in Indian economy. Institutions and research centres working on spices and condiments
2. Classification of spices- Different classifications based on economic importance, cultivation methods, family, longevity of spice plants, type of the spice, origin and flavor, plant part used, active principle.
3. Black Pepper - History, scope and importance, area and production, uses, export potential, botany, varieties, Soil and climate, selection of site, propagation – seed &vegetative - cuttings, rapid multiplication technique.
4. Black Pepper – establishment of pepper garden, planting of standard plants, planting of vines, shade and shade regulation, training and pruning of pepper vines, nutritional management, irrigation &weeding management, inter cultural operations, harvesting.
5. Cardamom – History, scope and importance, area and production, uses, export potential, botany, varieties, types of cardamom like Malabar, Mysore and Vazuka, soil and climate, selection of site, propagation– vegetative and sexual methods, advantages and disadvantages. Systems of cropping, inter cropping and mixed cropping, planting, shade regulation, nutrient management, irrigation, weeding, intercultural operations, thrashing, mulching, earthing up, raking, harvest indices and yield.
6. Turmeric- Introduction, importance and uses, area and production, botany, varieties, soil and climate, propagation, preservation of seed rhizome, selection of land and preparation. methods of cultivation like bed system, ridge and furrow system of planting, planting season, seed rate, spacing, mulching,irrigation, nutrient management, weeding and intercultural operations, cropping systems like inter cropping, rotations, harvesting- yield.
7. Ginger- Introduction, importance, area and production, uses, export potential, botany, varieties, soil and climate, propagation, preservation of seed rhizome, selection of land and preparation, planting season, seed rate and spacing, planting methods- bed system, ridge and furrow system, mulching, systems of cultivation- rotations and mixed cropping, irrigation, nutrition, weeding, harvesting, yield.
8. Nutmeg- History, importance, area and production, uses, botany, varieties, export value. Propagation – nursery techniques, soil and climate, planting, cropping systems like mixed cropping, manuring, weeding, constraints like sex determination and improvement in nutmeg cultivation, harvesting.
9. Cinnamon and Clove - Importance, area and production, uses, botany, varieties, export potential. Propagation – Seed, cuttings, nursery, soil and climate, planting, weeding, manuring, irrigation, harvesting.
10. Coriander – History, importance, area and production, uses, botany, varieties, soil and climate, sowing, seasons, seed rate, spacing, irrigation, weeding, intercultural operations, harvesting, yield
11. Ajowan – History, importance, area and production, uses, botany, varieties, soil and climate, sowing, seasons, seed rate, spacing, irrigation, weeding, intercultural operations, harvesting, yield
12. Fenugreek - History, importance, area and production, uses, botany, varieties, soil and climate, sowing, seasons, seed rate, spacing, irrigation, weeding, intercultural operations, harvesting, yield
13. Fennel and Cumin - Importance, area and production, uses, botany, varieties, soil and climate, sowing, seasons, seed rate, spacing, irrigation, weeding, intercultural operations, harvesting, yield
14. Vanilla - History, importance, area and production, uses, export value, botany, varieties, constraints of production, propagation by cuttings, soils and climate, land preparation, staking planting, manuring, flowering and pollination, hand pollination and harvesting.
15. Curry leaf - Introduction, area and production, uses, export value, soil and climate, propagation like seed and vegetative method- budding, approach grafting, planting. weeding, manuring, harvesting
16. Botanical name, Family, Economic part, Origin, Active principle and Uses of Garlic, Saffron, Thyme, Rosemary, Dill, Celery, Kokam, Allspice, Celery.
17. History and Development, scope and importance, area and production, export and import potential of plantation crops, role in national and state economy.
18. Role of different commodity boards, institutions and research centres working on Plantation crops.

19. COCONUT-Introduction, origin and distribution- area and production, botany, uses, composition and industrial importance, soil, climate, varieties. Propagation – seed propagation, selection of seed nuts, selection of mother palm, collection of seed nuts, Nursery – site selection and preparation, planting of seed nuts, management of nursery, selection of seedling for planting- planting systems and methods-preparation of pits and planting, gap filling-systems of cultivation.
20. COCONUT- Soil management mulching, weed management, water management, nutrient management. Flowering-pollination- hybridisation techniques-nut growth and development. Coconut based cropping system, Inter and multiple cropping, multi storied cropping-yield. Shedding of buttons, immature nuts, production of barren nuts and their control- Deficiency &disorders – crown choke- harvesting.
21. ARECANUT- Introduction, origin and distribution - area and production, Botany-Taxonomy- uses, composition and industrial importance, varieties- Soil and Climate-Propagation- seed and micro propagation- Nursery raising techniques- selection of mother palms, seed nut selection, primary and secondary nurseries – selection of nursery plant material. Establishment of plantation –planting systems and methods spacing, season of planting, nutrient management, soil management, mulching, weed management, water management. Cropping systems-multiple cropping, intercropping, mixed cropping, multi storied cropping. Flowering, pollination, fruit set, nut growth and development, harvesting, yield.
22. OIL PALM- Introduction, origin and distribution, area and production, botany and uses, composition and industrial importance. Types and varieties; propagation-seed propagation, raising of commercial Nursery (Single stage and double stage) – soil and climate –planting systems and methods, soil management-mulching, weed management, water management, nutrient management, physiological disorders-flowering, pollination, fruit set, fruit growth and development, harvesting, yield.
23. PALMYRAH -Introduction, origin and distribution -area and production- botany and uses, composition and industrial importance- types and varieties – Male & female palms differentiation, soil and climate. Propagation – Raising Nursery- Pre-treatment of seeds. Nursery practices – raising seedlings in situ, in mound nursery bed and in masonary bed-transplanting-planting methods, weed& water management, nutrient management cultural practices - leaf pruning, flowering, pollination, fruit set and fruit growth and development. Tapping of neera and tapping methods, yield.
24. COCOA-Introduction, origin and distribution- area and production, origin & distribution, botany and uses, composition and industrial importance –Types and varieties, climate, soil, propagation – criteria for mother tree selection, seed and vegetative propagation methods-cuttings, grafting and micro propagation, planting systems and methods - nutrient management, weed and water management, cocoa under shade, cropping systems-intercropping, types of branching, importance of training and pruning, flowering, fruit set, bean growth and development, harvesting and yield.
25. CASHEW NUT : Introduction, origin and distribution, Area and production, botany uses, composition and industrial importance- soils and climate- varieties and hybrids, Criteria for selection of mother plant, propagation – vegetative propagation, epicotyl grafting and cuttings- planting methods, high density planting.
26. CASHEW NUT- Branching pattern- intensive and extensive branches, training and pruning, soil management-mulching, soil conservation methods, weed management, water management, nutrient management, rejuvenation, flowering season, type of flowers, pollination, fruit and nut development, fruit drop, nutrient deficiencies and disorders – harvesting and yield.
27. COFFEE Introduction, origin and distribution –area and production, origin and distribution, botany and uses, composition and industrial importance- export, soil, climate, types, differences – Arabica/Robusta, branching – climatological differences, varieties, propagation-seed and vegetative methods, raising nurseries -preparation of main field and planting.
28. COFFEE- Shade trees – their characteristics, temporary shade and permanent shade, provision of shade and its regulation, advantages and disadvantages of shade, soil management- Inter cultural practices, digging, scuffling or soil stirring, trenching- mulching, weed management, water management, nutrient management –nutritional disorders, training and pruning – rejuvenation pruning, Flowering- season of flowering, hydro periodism, fruit set and control of premature fruit drop- harvest – types of harvest, types of beans – elephant bean, pea berry- bean disorders-yield.

29. TEA -Introduction, origin and distribution, area and production, Botany, Role of tea industry in Indian economy, export, uses, composition, soil and climate, varieties, propagation-vegetative propagation, varieties- method of planting and bush population, planting season, mulching, weeding, shade and its management.
30. TEA- Types of branching, training, pruning - types of pruning – 1. collar pruning. 2. medium pruning, 3. fringe or lung pruning, 4. skiffing, Rejuvenation pruning, soil management-mulching, weed management, water management, nutrient management - leaf plucking, yield of leaves.
31. RUBBER- Introduction, origin and distribution, area and production, Botany and uses, composition and industrial importance- climate and soil, varieties and types, propagation-seeds, vegetative methods, bud wood for stump planting, basket plants, types of planting material, improved clones, polyclonal seed garden.
32. RUBBER- Planting – season, manuring, soil management- cover crops, irrigation, weeding-Types of rubber trees-Practices followed in Immature rubber trees and mature rubber trees, harvesting- tapping – tapping systems, puncture tapping, slaughter tapping, use of growth regulators for latex flow, rain guarding, latex collection, yield of latex

Practical:

1. Introduction and identification of Plantations and spices
2. Institutions and research centres working on Plantations and spices
3. Study on different propagation methods of Pepper and Cardamom
4. Study on different propagation methods of Ginger and Turmeric
5. Study on maturity indices and harvesting of Major spices
6. Study on maturity indices and harvesting of seed spices
7. Study on adulterants used in the spices and spice products
8. Mother palm selection and raising of nursery for Coconut and Areca nut
9. Layout and planting of Palms
10. Seed treatment and nursery raising of Oil palm
11. Propagation, training and pruning of Cashew
12. Propagation, training and pruning of Cocoa
13. Maturity indices and harvesting in Cashew, Cocoa, Tea and Coffee
14. Tapping in rubber
15. Working out the economics and project preparation for Coconut, Areca nut, Oil Palm, Cashew and Cocoa
16. Visit to Plantation nursery/ estate/ research station

References:

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

Course No : ASMJ- 1.9.1
Course Title : Weed and Water management in Horticultural Crops 2 (1+1)

Lecture Outline:

A) Theory

1. Introduction - weed definition - harmful and beneficial effects of weeds - classification based on morphology, life cycle, cotyledonary number and crop weed association
2. Propagation of weeds - sexual - asexual - vegetative reproduction - Dispersal of weed seeds and fruits
3. Weed Biology - characteristic features of weeds - weed ecology - definition - persistence of weeds -- critical period of crop-weed competition – allelopathy
4. Concepts of weed prevention, control and eradication. Methods of weed management –physical, mechanical and cultural

5. Chemical and biological methods of weed control - Integrated weed management
6. Herbicides - definition - advantages and limitations of herbicide usage in India- classification of herbicides based on selectivity, translocation, time, method of application and formulations
7. Adjuvants – definition, their use in herbicide application –adsorbents and antidotes
8. Selectivity of herbicides – fundamental principles of selectivity - differential rate of absorption - differences in morphology and growth habit of plants - rate of translocation
9. Selectivity of herbicides - differential rate of deactivation of herbicides – metabolism - reverse metabolism – conjugation - protoplasmic resistance to the specific herbicide
10. Importance of water – definition –Water resources of India and A.P- Important irrigation projects in India and A.P
11 Soil-water relationships - Importance of soil, plant and water relationship (SPAC) - physical properties of soil influencing water retention - texture, structure and depth, particle density, bulk density and pore space in relation to moisture retention, movement and availability
12. Adhesion & cohesion – soil moisture tension/soil water potential – Soil moisture characteristic curves - infiltration – permeability – seepage – percolation
13. Soil moisture constants - saturation, field capacity, PWP, hygroscopic coefficient, moisture equivalent, available soil moisture - theories of water availability – kinds of soil water
14. Moisture sensitive periods - Irrigation scheduling – Approaches – Soil (feel and appearance, gravimetric, soil moisture tension), plant (leaf temperature, leaf water potential, visual plant symptoms, stomatal resistance) and climatological approach – PET method– IW/CPE method and pan evaporation
15. Methods of irrigation – classification – surface methods – flooding, check basin, basin, Border and furrow method of irrigation–
16. Drip irrigation, Sprinkler irrigation – advantages and disadvantages - Fertigation — merits and demerits – criteria to judge the quality of irrigation water

B) Practicals:

1. Identification and survey of weeds
2. Herbarium preparation of weeds
3. Weed vegetation analysis
4. Herbicide label information& list of commonly available herbicides
5. Computation of herbicide doses
6. Study of herbicide application equipment
7. Demonstration of methods of herbicide application
8. Precautionary measures to be taken while spraying herbicides
9. Determination of soil moisture content by thermo gravimetric method (Direct method)
10. Estimation of soil moisture by tension meter and pressure plate apparatus (Indirect methods)
11. Estimation of soil moisture by gypsum blocks and neutron moisture meter
12 Estimation of soil moisture constants (FC and PWP)
13. Scheduling irrigation using IW/CPE method
14 & 15. Calculation of irrigation water needs
16. Lay out of drip and sprinkler methods of irrigation

References:

- Gupta, O.P. 1984. *Scientific Weed Management*. Today and Tomorrow Printers and Publishers, New Delhi.
- Gupta, O.P. 2011. *Modern Weed Management*. Agro Bios (India), Jodhpur.
- Rao, V.S. 2000. *Principles of Weed Science*. Oxford & IBH Publishing Co., New Delhi.

- Subramanian, S., Mohammed Ali, A. and Jayakumar, R. 1991. *All About Weed Control*.Kalyani Publishers, Ludhiana.
- Tadulingam, C. and Venkatnarayana, D. 1955. *A Handbook of Some South Indian Weeds*
- Yellamanda Reddy, T. and Sankara Reddi, G.H. 2010. Principles of Agronomy. Kalyani Publishers, Ludhiana
- A Practical Manual for Water Use Research :Dastane N G 1967, Navabharat Publications, Poona
- Irrigation -Principles and Practices: Israelsen**O** W and Hansen V E 1962, JohnWilley& Sons Inc.,USA.
- Efficient Use of Irrigation Water :Sankara Reddy G H and Yellamanda Reddy T,1996, Kalyani Publishers
- Irrigation Agronomy : S R Reddy, Kalyani Publishers
- Weeds of the world-Biology and control by LJ King
- Weed management by US Walia
- Weed ecology by SR Radosevich and JS Holt
- Other related books and internet sites

Course No : ESAE- 1.11.2
Course Title : Personality Development 2 (1+1)

Lecture Outline:

Theory:

1. Personality Definition- Nature of personality, theories of personality and its types.
2. The Humanistic approach - Maslow's self-actualization theory, shaping of personality, determinants of personality
3. Myers-Briggs Typology Indicator, Locus of control and performance,
4. Type A and Type B behaviour, personality and Organizational behaviour.
5. Foundations of individual behaviour and factors influencing individual behavior
6. Models of individual behaviour
7. Perception and attributes and factors affecting perception
8. Attribution theory and case studies on Perception and Attribution.
9. Learning; meaning and definition, theories and principles of learning
10. Learning and organizational behavior
11. Learning and training, learning feedback.
12. Attitude and values
13. Intelligence- types of Intelligence, theories of intelligence, measurements of intelligence, factors influencing intelligence
14. Intelligence and Organizational behavior, emotional intelligence.
15. Motivation- theories and principles
16. Team work and group dynamics.

Practical:

1. Practice on Myers-Briggs Type Indicator(MBTI) Personality
2. Learning styles and strategies practice
3. Firo-B Inter personal Communication Practice
4. Effective Team work practice
5. Group dynamics for growth
6. Win-win game
7. Conflict management strategies
8. Identifying leadership qualities and styles, motivation
9. Case study analysis
10. Positive attitude and soft nature exercise
11. Stress management exercise
12. Quiet time for enhancing life peace expectancy rate
13. Time management exercise
14. Professional behavior
15. Building personal career and life
16. Family responsibility, Society responsibility

References:

- Andrews, Sudhir, 1988, How to Succeed at Interviews. 21st (rep.) New Delhi. Tata
- Heller, R, 2002, Effective Leadership. Essential Manager series. Dk Publishing.

- Hindle, T, 2003, Reducing Stress. Essential Manager series. Dk Publishing
- Lucas, S, 2001, Art of Public Speaking. New Delhi. Tata - Mc-Graw Hill.
- Mile, D.J, 2004, Power of Positive Thinking. Delhi. Rohan Book Company.
- Pravesh K, 2005, All about Self- Motivation. New Delhi. Goodwill Publishing House.
- Seven Habits of Highly Effective People – Stephen Covey
- Shaffer, D. R, 2009, Social and Personality Development (6th Edition). Belmont, CA:
- Smith, B, 2004, Body Language. Delhi: Rohan Book Company.
- Social Psychology: By Robert S Feldman. (Tata McGraw Hill Publishing)
- Three Basic Managerial Skills For All – Hall Of India Pvt Ltd New Delhi
- Understanding Psychology: By Robert S Feldman. (Tata McGraw Hill Publishing) Wadswor.
- Wehtlel David A and Kin S Kemerron – Developing Managerial Skills – Pearson Education New Delhi.
- You Can Win – Shiv Khera

Course No : ESMD - 1.11.2
Course Title : Entrepreneurship Development and Business Management 3 (2+1)

Lecture Outline:

Theory

1	Nature and scope of economics, definitions and divisions of economics
2-3	Classification of goods; Wants – their characteristics and classification. Utility, forms of utility, utility measurement, cardinal and ordinal
4	Demand - meaning, definition, types, Demand schedule, demand curve, law of demand – contraction and extension, increase and decrease in demand
5	Elasticity of demand - meaning, Types and Degrees of elasticity of demand, practical importance of elasticity of demand
6	Supply - meaning, definition, law of supply- supply schedule, supply curve, Increase and decrease in supply, contraction and extension of supply, Elasticity of supply, Degrees of elasticity of supply
7	National Income –concepts of national income - Gross domestic product, gross national product, net national product, net domestic product- national income at factor cost, personal income, disposable income
8	Inflation-meaning-causes of inflation, Business cycle-phases
9	Market equilibrium-Price determination-Factors of production
10	Entrepreneurship- Concept, need and importance, Objectives, Classification of entrepreneurs
11	Functionsofentrepreneurs-Roleofentrepreneurshipineconomicdevelopment
12	SWOT analysis – Advantages and Disadvantages
13	Generation, Incubation and commercialization of business ideas
14-15	Entrepreneurial policies and schemes by Government of India
16	Different forms of business organizations-Selection of form of ownership
17-18	Steps involved in establishment of an enterprise. Selection of the product / services, registration, selection of site, capital sources, acquisition of manufacturing, know how, packaging and distribution
19-20	Planning of an enterprise, project identification, selection and formulation of project, Project report preparation
21	Management-concept, functions, scope of management and objectives
22	Productionmanagement,relationshipamong5P's,Typesofplant layouts
23	Quality control and Total quality management–Principles
24	Materials management-objectives, inventory and its control techniques
25	Personnel management-concept-selection, retention, incentives, training & development, evaluation *etc.*

26-27	Marketing management-functions, components of marketing mix (4P's)-product, price, promotion and place, marketing strategies
28-29	Financial management -objectives, fixed capital and working capital, Preparation of financial statements –Balance sheet, income statement and cashflow statement
30	Costing and pricing, long term planning and short-term planning
31	Book keeping, journal, ledger and subsidiary books
32	Crisis management-raw material, production, leadership, market, finance, natural *etc*

Practical

1-2	Estimation of demand and supply for various horticultural commodities in India
3-4	Visit to small scale industries / agro-industries –SWOT analysis
5-6	Interaction with successful entrepreneurs/agri-entrepreneurs.
7-8	Visit to financial institutions and support agencies
9-10	Preparation of project proposal for funding by different agencies.
11-12	Case studies of different forms of business organizations
13	Estimation of Economic order quantity (EOQ)
14	Preparation of financial statements
15	Calculation of different financial ratios
16	Case studies of successful startups/enterprises in agriculture/horticulture

References

- Charantimath P.M.,2009. Entrepreneur ship Development and Small Business Enterprises .Pearson Publications, NewDelhi.
- DesaiV.,2015, Entrepreneurship: Development and Management, Himalaya Publishing House.
- GuptaCB.2001. Management Theory and Practice. Sultan Chand &Sons.
- KhankaSS.1999.Entrepreneurial Development. S.Chand&Co.
- MehraP.,2016,Business Communication for Managers. Pearson India, NewDelhi.
- PandeyM .and TewariD.,2010, The Agribusiness Book.IBDC Publishers, Lucknow.
- SinghD.1995. Effective Managerial Leadership. Deep & Deep Publ.
- Singhal R.K.,2013, Entrepreneurship Development & Management, Katson Books.
- Tripathi P C & Reddy P N.1991. Principles of Management. Tata Mc Graw Hill.
- Vasant Desai,1997. Small Scale Industries and Entrepreneurship. Himalaya Publ. House

Course No : HEVA-1.12.1
Course Title : Environmental Studies and Disaster Management 3(2+1)

Lecture Outline:

Theory:

1 Multidisciplinary nature of environmental studies definition, scope and importance, Natural resources and associated problems.
2 Forest resources: use and over exploitation, deforestration, case studies. Timber extraction, mining, dams and their effects on forest and tribal people.
3 Water resources: Use and over utilization of surface and ground water, floods, drought conflicts over water, dams – benefits and problems.
4 Mineral resources: use and exploitation, Environmental effects of extracting and using mineral resources, case studies.
5 Food resources: world food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer – pesticide problems, water logging, salinity case studies.
6 Energy resources: growing energy needs, renewable and non renewable energy resources, use of alternate energy sources, case studies.

7 Land resources: land as a resource, land degradation, man induced land slides, soil erosion and desertification. Role of individual in conservation of natural resources. Equitable use of resources for sustainable life styles.
8 Ecosystems, concept of an ecosystem, structure and function of an ecosystem: producers, consumers and decomposers. Energy flow in the ecosystem, ecological successions, food chains, food webs and ecological pyramids.
9 Forest ecosystem and grass land ecosystem: Introduction, types, characteristic features structure and functions.
10 Desert ecosystem and aquatic ecosystem (ponds, streams, lakes, rivers, oceans and estuaries): Introduction, types, characteristic features structure and functions.
11 Biodiversity and its conservation: Introduction, definition genetics, species and ecosystem diversity and bio geographical classification of India. Valve 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. Hotspots of biodiversity. Threats to biodiversity – habitat loss, poaching of wild life, man wild life conflicts.
13 Endangered and endemic species of India, conservation of biodiversity: In-situ and Ex-situ conservation of Biodiversity.
14 Air pollution: definition, cause effects and control measures.
15 Water Pollution: definition, cause, effects and control measures.
16 Soil Pollution: definition, cause, effects and control measures.
17 Marine and noise pollution: definition, cause effects and control measures.
18 Thermal Pollution, Nuclear hazards: definition, cause, effects and control measures.
19 Solid Waste Management: causes effects and control measures, urban and industrial wastes, role of an individual in prevention of pollution.
20 Social issues and the environment: From unsustainable to sustainable development, urban problems related to energy, water conservation, rain water harvesting, watershed management.
21 Environmental ethics: Issues and possible solutions, climate change, global warming, acid rain ozone layer depletion, nuclear accidents and holocaust dies.
22 Waste land reclamation, consumerism and waste products.
23 Environment protection act, air, water , wild life and forest conservation acts. Issues involved in enforcement of environmental legislation and public awareness.
24 Human population and environment: population growth, variation among nations, population explosion, family welfare programme.
25 Environment and human health: human rights, value education HIV/AIDS, women and child welfare.
26 Role of information technology in environment and human health.
27 Natural disasters – meaning and nature of natural disasters, their types and effects – floods, drought.
28 Cyclones, earth quakes, landslides, avalanches, volacanic eruptions, heat and cold waves.
29 Climate change – Global warming, sea level rise, ozone depletion.
30 Man made disasters – Nuclear disasters, chemical disasters, biological disasters, building fire, coal fire, forest fire, oil fire, air pollution, water pollution.
31 Deforestation – effect to migrate natural disaster at natural and global levels. International strategy for disaster reduction.
32 Concept of disaster management, national disaster management framework, financial arrangements; role of NGO's, community based organizations and media. Central, state district and local administration; armed forces in disaster response; disaster response; police and other organisation.

Practical

1. Collection, processing and storage of effluent samples.
2. Determination of chemical oxygen demand (COD) in waste water sample.
3. Determination of dissolved oxygen (DO) in waste water sample.
4. Determination of total dissolved salts in waste water sample.
5. Analysis of temporary hardness of waste water sample.
6. Analysis of total hardness of waste water sample.
7. Assessment of Chlorophyll content of plants.
8. Determination of biological oxygen demand (BOD) in waste water sample.
9. Analysis of waste water for heavy metals.
10. Estimation of respirable and non respirable dust in air by using dust sampler.
11. Field work: Visit to local area to document environmental assets river / forest/ grassland/ hill/ mountain.
12. Visit to a local polluted site – urban/ rural/ industrial/ agricultural.

13. Study of common plants, insects, birds and study of simple ecosystems – pond, river, hill slopes etc.
14. Visit to industries to study pollution abatement techniques
15. Case studies – Solid Waste Management.
16. Visit to In-situ or Ex-situ conservation centre / social service organisation / Environmental education centre.

References:

- Erach Bharucha 2005.Text book of Environmental Studies for Under Graduate Courses University Grants Commission, University Press, Hyderabad.
- Manohara Chary and Jaya Ram Reddy 2004.Principles of Environmental Studies , BS Publishers, Hyderabad
- William, P. Cunning Ham and Mary Ann Cunningham 2005 Principles of Environmental Science Inquiry and Applications Tata MCG raw-hill publishing company Limited,New Delhi.
- Gupta, P.K. 2004. Methods in Environmental Analysis - Water, Soil and Air .Agro bios (India). Jodhpur

Course No : PTMJ-1.7.1
Course Title : Principles of Integrated Pest and Disease Management 1 (0+1)

Lecture Outline:

Practical

1. Concepts and Components of Integrated pests and disease management.
2. Establishment of IPDM demonstration plot.
3. Sampling techniques for estimation of insect and disease incidence.
4. Survey, surveillance and forecasting of pest and disease incidence.
5. Data recording on pest, disease incidence and natural enemy population in IPDM plot
6. Correlation of pest, disease incidence and natural enemy population with abiotic factors in horticultural crops
7. Study of various pesticide and fungicide formulations and calculations of doses/concentrations of different formulations
8. Pesticide application methods and safety precautions
9. Study and maintenance of various plant protection appliances
10. Installation of various IPDM components (Light traps, sticky traps, pheromone trap, bait traps, border crops, inter crops repellent crops, bird perches, spore traps, etc)
11. Application and evaluation of Microbial biopesticide (*Trichoderma* spp)
12. Application and evaluation of Microbial biopesticides (*Pseudomonas* spp, *Bacillus* spp.)
13. Preparation and evaluation of botanical pesticides [NSKE 5 %, neem oil, pongamia oil] and micro-nutrient application.
14. Inoculative and inundative release of Parasitoids and Predators in Horticultural Crops
15. Mass multiplication and on-farm production methods of microbial biopesticides.
16. Visit to bio- control laboratory/IPDM plots

References:

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- Reddy, P. P., 2010, Plant Protection in Horticulture Vol. 1, 2 & 3, Scientific Publishers, Jodhpur.
- Ranjit, P., 2012, Entomological Techniques in Horticultural Crops, New India Publishing Agency.
- Rachna and Benna kumari. Pest management and residual analysis in horticultural crops.
- Fry W Principles of plant disease management, Academic Press, Newyork.

- Mayee CD and Dadar,VV Phytopathometry, Technical bulletin-1(Special bulletin-3), Maratwada Agril. University, Parbani
- Nagarjan, S and Muralidharan K,1995.Dynamics of Plant Pathology. Allied Publication, New Delhi
- Cook R.J and Baker, K.F 1983.Nature and Practice of biological control of plant pathogens, APS St Paul Minnesota, Cambridge University
- Dingra OD and Sinclair JB, Basic plant Pathology methods.1986.CRC Press London
- Emmanuel, N, A. Sujatha, T.S.K. K. Kiran Patro, MLN Reddy, B. Srinivasulu, TSSK Patro. Text Book on Integrated Pest Management of Horticultural Crops Astral International Publishers, New Delhi.

Course No : NSAE- 1.0.2
Course Title : National Service Scheme (NSS-II) (0+1)

Lecture Outline:

Practical :

1. Importance and role of youth leadership
2. Meaning, types and traits of leadership, qualities of good leaders
3. Importance and roles of youth leadership.
4. Life competencies : Definition and importance of life competencies, problem-solving and decision-making, interpersonal communication.
5. Youth development programs : Development of youth programs and policy at the national level, state level and voluntary sector; youth-focused and youth-led organizations.
6. Natural energy resources
7. Health, hygiene and sanitation : Definition, need and scope of health education; role of food, nutrition, safe drinking water, water borne diseases and sanitation (Swachh Bharat Abhiyan) for health; national health programs and reproductive health.
8. Food waste management : solid waste management, composting and vermicomposting.
9. Bio-waste management
10. Rainwater harvesting and its appliances.
11. Watershed management
12. Youth health, lifestyle, HIV AIDS and first aid.
13. Healthy lifestyles, HIV AIDS, drugs and substance abuse, home nursing and first aid.
14. Green cover management – components, vertical gardens , go green
15. History, philosophy, concept, myths, and misconceptions about yoga; yoga traditions and its impacts, yoga as a tool for healthy lifestyle, preventive and curative method
16. E-waste management

SKILL ENHANCEMENT COURSES-II

Course No : FLSE-1.3.1

Course Title : Landscape Gardening 2 (0+2)

Lecture Outline:
Practicals:

1. Study of symbols, tools and implements used in landscape design.
2. Study of identification, classification and growth characters of ornamental trees
3. Study of identification, classification and growth characters of shrubs
4. Study of identification, classification and growth characters of climbers
5. Study of identification, classification and growth characters ground covers and indoor plants
6. Making and maintenance of edges and hedges
7. Making and maintenance of topiary.
8. Bonsai making, Criteria for selecting plants, Examples - Classification of Bonsai ,Upright (formal and informal) , Winding , Oblique, Gnarled, Semi-cascade, Cascade clasped to stone
9. Bonsai making -Containers (pots) and Media, Potting and Re-potting

10. Training, Pruning and Pinching (Shoot, leaf and root), Watering, manuring, defoliation, Mame Bonsai.
11. Identification and selection of lawn grasses
12. Land preparation, manuring and methods of planting lawn
13. Maintenance of lawn – Mowing
14. Maintenance of lawn – Rolling
15. Maintenance of lawn – Sweeping and scraping
16. Maintenance of lawn – Raking and weeding
17. Maintenance of lawn – Irrigation and top dressing
18. Maintenance of lawn – Top dressing with compost and fertilizers
19. Maintenance of lawn – Diseases and other problems – Fairy ring – Pale Yellow Lawns.
20. Study of principles to be observed in preparation of landscape design & elements of landscape design
21. Study of various features of an ornamental garden with suitable plants and identification of plants for each feature.
22. Study of formal gardens i.e., Mughal, Persian, Italian and French gardens with their different features.
23. Study of informal gardens i.e., Japanese and English gardens with their different features; and wild, countryside.
24. Landscape design process: Landscape drafting tools. Dimensioning, graphic symbols and notations
25&26. Study of landscaping Highways, Railway stations, Bus terminus and Airports.
27 &28. Study of landscaping cities, towns, countryside, canals and along the bank of rivers.
29 &30. Study of landscaping factories, places of historic importance, places of worship.
31. Visit to nearby nurseries of ornamental plants.
32. Visit to community parks and Institutional gardens

References:

- A.K. Tiwari and R. Kumar. 2012. Fundamentals of ornamental horticulture and landscape gardening. New India.
- H.S.Grewal and Parminder Singh. 2014. Landscape designing and ornamental plants
- R.K. Roy. Fundamentals of Garden designing.2013.New India publishing agency, Pitampura, New Delhi.
- Rajesh Srivastava. 2014. Fundamentals of Garden designing. Agrotech press, Jaipur, New Delhi.
- L.C. De. Nursery and landscaping.2013. Pointer publishers, Jaipur India.
- Bose, T.K. Malti, R.G. Dhua, R.S. & Das, P. 2004. Nayaprakash, Calcutta. Floriculture and Landscaping
- Arora, J.S. 2006. Kalyani publishers, Ludhiana. Introductory Ornamental Horticulture. Kalyani publishers, Ludhiana.
- Randhawa, G.S. and Amitabha Mukhopadhyay 2004. Floriculture in India. Allied Publishers Pvt. Ltd., New Delhi.

Course No : PHSE-1.5.1
Course Title : Packing and Packaging of Horticultural crops 2 (0+2)

Lecture Outline:

Practical:

1	Overview of the importance of packing and packaging in the horticultural industry
2	Introduction to various types of packaging material:Traditional,Advanced,Recent
3	Hands-on practice: Preparing produce for packing
4	Packing Techniques
5	Important physical parameters of different packaging materials
6 and 7	Cushioning material and demonstration of different cushioning material
8 and 9	Determination of water vapour transmission rate (WVTR) and gas transmission rate (GTR) of packaging material.

10	Techniques for efficient and effective packing to minimize damage and maximize space.
11	Hands-on practice: Packing various types of horticultural produce (e.g., fruits, vegetables, herbs).
12	Determination of shelf-life of packed products in different types of packages.
13	Modified atmospheric packaging techniques and shelf life studies
14	Aseptic packaging: Concepts
15	Vacuum packaging: concepts and demonstration
16	Shrink Wrapping:Concepts and demonstration
17	Controlled atmospheric packaging for shelf-life enhancement
18	Best practices for storing packed produce to maintain quality
19 -20	Techniques for inspecting and testing packed produce (e.g., firmness tests, visual inspection)
21	Study on fancy packaging material
22	Study on biodegradable packaging material
23 - 24	Coding and labeling of food packages
25	Overview of industry standards and best practices in packing and packaging
26	Recycling of Packaging Materials
27	Migration of toxic substances from package to food products
28	Different type of damages occurring in horticultural crops during transportation.
29-30	Visit to vegetable and fruit markets
31-32	Visit to commercial pack house

References

- Ahvenainen R. 2001. Novel Food Packaging Techniques. CRC. 7 6 A.K. Thompson 2010,
- Food packaging materials. Tata McGraw Hill. Painy FA. 1992.
- A handbook of food packaging. Blackie Academic. Pantastico B. 1975.
- Post Harvest Physiology, Handling and Utilization of Tropical and Subtropical Fruits and Vegetables. AVI Publ. Robertson GL. 1992.
- Food Packaging-Principles and Practices. Marcel Dekker. Sacharow S and Griffin RC. 1980. Principles of Food Packaging. AVI Publ. Salunkhe DK & Kadam SS. 1998.

Course No : HESE-1.12.1
Course Title : Farm Machinery 2 (0+2)

Course Content :

Familiarization with different makes and models of agricultural tractors, Identification of various functional systems including air supply, fuel, cooling, transmission, steering and hydraulic systems. Maintenance points to be cheeked before starting a tractor. Familiarization with controls on a tractor. Safety rules and precautions to be observed while driving a tractor. Practice of driving a tractor and with tillage tools (Primary/Secondary tillage implements) and their adjustment in the field. Ficid patterns while operating a tillage implement. Hitching and de hitching of mounted and trailed type implements to the tractor. Practice for driving of a trailed type of trolley: forward and in reverse direction. Familiarization with different types of sprayers. Operation of tractor operated boom and orchard sprayers. Calibration of a sprayer. Nozzle spacing on a boom, pressure setting of a nozzle. Use of Pick Positioner. Use of drones for spraying. Familiarization with tractor operated tree pruners.

Lecture Outline:

Practicals:

1. Study of different Makes and Models of Agricultural tractors
2. Study of different Makes and Models of Agricultural tractors
3. Identification of different Functional Systems of Agricultural tractors
4. Study of Fuel supply system of tractor

5. Study of Cooling system of Tractor
6. Study of Ignition systems of tractor
7. Study of Power transmission system of tractor
8. Study of Steering and Hydraulic system of a tractor
9. Study of Maintenance points to be checked before starting of a tractor
10. Familiarisation with controls of tractor
11. Safety rules and precautions to be observed while driving a tractor
12. Learning of tractor driving-1
13. Learning of tractor driving-II
14. Learning of tractor driving - III
15. Learning of tractor driving-IV
16. Learning of tractor driving-V
17. Hitching of tractor drawn implements
18. Hitching and de-hitching of mounted and trailed type implements to the tractor
19. Practice of tractor driving forward and in reverse direction
20. Assembling and Dismantling of different types of plant protection equipment
21. Assembling and Dismantling of different types of plant protection equipment
22. Operation of different types of plant protection equipment
23. Operation of tractor operated boom and orchard sprayers
24. Calibration of Sprayer
25. Study of nozzle spacing on a boom and pressure setting of a nozzle
26. Familiarization with tractor operated tree pruners
27. Study of Post-hole digger
28. Study of Grafting, pruning and training tools and equipment
29. Study of Grafting, pruning and training tools and equipment
30. Operation of harvesting machines like fruit pluckers, potato harvester
31. Practice of drone spraying
32. Practice of drone spraying

References:

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- Jain, S.C. 2003. Farm Machinery-An Approach, Standard Publishers and Distributors, NewDelhi.
- Kepner, R.A., Roy Bainer and Barger, E.L. 1987. Principles of Farm Machinery. CBS Publishers
- and Distributors, New Delhi.
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- Nokra. C.P. 1986. Farm Machinery and Equipment. DhanpatRai and Sons. New Delhi.

Course No : PTSE-1.7.2

Course Title : Production Technology for Bio-Agents and Bio-fertilizers 2 (0 + 2)

Lecture outline:

Practical:

1. Identification of common predators of crop pests.
2. Mass production of rice moth, *Corcyra cephalonica* (laboratory host).
3. Mass production of *Trichogramma s*pecies (egg parasitoid).
4. Mass production of *Bracon hebetor.* (larval parasitoid)
5. Mass production of *Goniouzus nephantidis.* (larval parasitoid)
6. Mass production of *Brachymeria nosotoi* (Pupal parasitoid)
7. Mass production of *Chrysoperla zastrowi* (Predator)

8. Mass production of *Cryptolaemus montrouzieri* (Predator)
9. Mass multiplication of *Zygogramma bicolorata* (natural enemies of weed)
10. Field collection and preservation of parasitoids, predators and weed killers
11. Mass production of *Beauveria bassiana* (white muscardine fungus)
12. Mass production of Nuclear Polyhedrosis Virus (Entomopathogenic virus)
13. Field release/application of parasitoids against crop pests
14. Field release/application of predators against crop pests.
15. Mass production of entomopathogenic nematodes
16. Quality control and registration standard for biological control agent.
17. Isolation and enumeration of fungal/bacterial biocontrol agents from soil
18. Purification of fungal/bacterial biocontrol agents
19. Isolation, identification of fungal (*Trichoderma harzianum* and *Pacelomyces lilacinus*) antagonistic organisms
20. Isolation, identification of bacterial (*Pseudomonas fluorescens* and *Bacillus subtilis*) antagonistic organisms

20-21. Mass production of *Trichoderma harzianum* and *Pacelomyces lilacinus* (Isolation, preparation of mother culture, sterilisation of media, inoculation, multiplication, quality analysis, mixing, packing and labeling)

22-23.Mass production of *Pseudomonas fluorescens* and *Bacillus subtilis* (Isolation, preparation of mother culture, sterilisation of media, inoculation, multiplication, quality analysis, mixing, packing and labeling)

24. Studies on antagonistic ability of fungal, bacterial biocontrol agents through dual plate technique

25-26. Field Evaluation of biocontrol agents; Evaluation of biocontrol agents against diseases of vegetables under protected cultivation

27-28. Isolation and purification of Azospirillum, Azotobactor, Rhizobium, P-solubilizers/mobilisers K-solubilizers and Zn-solubilizers

29-30. Development of consortia, Mass Production Techniques (Carrier based and Liquid Biofertilizers).

31. Visit to bio-control laboratory.

32. Visit to bio-fertilizer production unit.

References :

- Burges HD and Hussey NW. (Eds). 1971. *Microbial Control of Insects and Mites.* Academic Press, London.
- De Bach P. 1964. *Biological Control of Insect Pests and Weeds.* Chapman and Hall, New York.
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- Dr. Himadri Panda. The Complete Technology Book on Biofertilizer and Organic Farming.
- Bhoopander Giri, Ram Prasad, et al. Biofertilizers for Sustainable Agriculture and Environment (Soil Biology Book 55)
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- Michael Madigan, John Martinko, David Stahl and David Clark, Brock. Biology Of Microorganisms, Pearson (Thirteen Edition)

- Mark S. Coyne, Soil Microbiology.An Exploratory Approach, Delmar Publishers-2004
- Atlas Bartha, Microbial Ecology . Fudamentals And Application, Pearson (Fourth)
- J Nicklin, K Graeme-Cook, T.Paget And R. Killington. Instant Notes In Microbiology.
- Koul, G S Dhaliwal, S Khokhar. Biopesticides in Sustainable Agriculture Progress and Potential Hardcover 1 January 2014
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- Woolmer PL & Swift MJ. 1994. The Biological Management of Tropical Soil Fertility.
- Franklin R. Hall, Julius J. Menn Dwijendra Singh . Advances in Plant Biopesticides

III SEMESTER COURSES

Course No : ASMN-2.9.1

Course Title: Fundamentals of Soil Science 3 (2+1)

Lecture Outline:

Theory:

1. Introduction - Spheres of the earth atmosphere, hydrosphere and lithosphere – Their characteristics – Origin of soil – Composition of Earth's Crust, Soil as a natural body. Soil and soil components – Mineral matter, organic matter, water and air – Definition of soil and various concepts of soil – Branches of soil science.
2. Rocks – Classification of rocks based on mode of origin –Igneous rocks, sedimentary rocks and metamorphic rocks – Classification of rocks based on silica content.
3. Minerals – Definition, classification of minerals based on abundance, Primary, secondary, essential and accessory minerals – Primary minerals – Quartz, feldspar, micas, pyroxenes, amphiboles and olivines – Weatherability of primary minerals.
4. Non-silicate minerals – P, Ca, Mg, S and micronutrient containing minerals –Secondary silicate minerals – types of secondary silicate minerals, Basic structural units and properties, amorphous silicate minerals.
5. Weathering of rocks and minerals: definition, types- physical, chemical and biological weathering, factors influencing weathering, products of weathering, weathering sequence
6. Soil formation: factors of soil formation, active factors like climate, organisms and passive factors like parent materials, topography and time.
7. Parent material – Classification of parent materials based on their mode of transport by different agents - Soil formation – Soil forming factors – Classification and their role in soil formation – Catena – Definition.
8. Pedogenic processes of soil formation: basic/ fundamental processes and specific pedogenic processes. Soil profile: Description of soil profile, Master horizons, transitional horizons and subordinate horizons. Differences between surface soil and sub soil.
9. Soil physical properties: Soil texture- definition, soil separates (USDA and ISSS) and their properties, methods of textural analysis, Particle size analysis – Stoke's law; derivation, assumptions and limitation of Stoke's law. Textural classes, Use of textural triangle.
10. Soil structure: classification based on types, class and grade, importance, mechanism of aggregate formation, factors affecting soil structure and evaluation of soil structure. Management of soil structure.

11. Soil density: particle density, bulk density; their relationships, factors influencing soil bulk density and particle density, importance
12. Soil porosity: Definition, types of pores, factors affecting porosity and importance. Soil colour: Attributes (hue, value and chroma), its significance, factors affecting soil colour - parent material, soil moisture and organic matter
13. Soil consistency: forms (Hard, soft, plastic and sticky consistency), factors affecting consistency, Atterberg's limits, and significance, Factors affecting plastic limits – Significance of soil consistency
14. Soil water – Forces of soil water retention – pF concept – Soil moisture characteristic curves – Importance of soil water. 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 constants
15. Soil water movement – classification, measurement- gravimetric- electric and tensiometer interpretation methods- Pressure plate and pressure membrane apparatus – Neutron probe.
16. Soil water content – 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.
17. 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.
18. Soil air – Compositions of atmospheric air and soil air – Gaseous exchange –Influence of soil air on plant growth, soil properties and nutrient availability – Measurement of oxygen diffusion rate – Measures to improve soil aeration.
19. Soil crusting - management of Soil Crusting, Soil Compaction and Compression, Soil degradation.
20. Soil colloids – Definition – General properties – Shape, surface area, electrical charge, adsorption, flocculation, de flocculation, plasticity, cohesion, swelling, shrinkage, Tyndall effect and Brownian movement.
21. Origin of charge in organic and inorganic colloids – Negative and positive charges – Differences between organic and inorganic soil colloids.
22. Adsorption of ions – Types of ion exchange – Cation and anion exchange – Cation and anion exchange capacities of soil – Base saturation – Factors affecting ion exchange capacity of soils – Importance of Cation Exchange Capacity (CEC) and Anion Exchange Capacity (AEC) of soils – Calculation of base exchange capacity and exchangeable acidity.
23. Soil reaction, pH, soil acidity and alkalinity, buffering, effect of pH on nutrient availability.
24. Soil biology – Biomass – Flora and fauna – Their important characteristics – Role of beneficial organisms – Organic matter decomposition, mineralization and immobilization. Nitrogen fixation, de nitrification , solubilisation of phosphorus and biological control of plant diseases – Promotion of plant growth promoting substances –Harmful activities of soil organisms.
25. Soil organic matter – Various sources – Composition – Compounds in plant residues – Their decomposability – Humus – Definition – Synthesis of humus, importance - Fractionation of

soil humus – Carbon cycle – Carbon : Nitrogen (C:N) ratio of commonly available organic residues – Significance of C:N ratio in soil fertility.

26. Soil Survey – objectives, Base maps - cadastral maps, topographic maps, aerial photography– satellite of soil features – their interpretation, Methods and Types of Soil survey, orders of soil survey.
27. GIS – components and working principle, GPS, Remote sensing- Principle, types, applications in soil and plant studies. Land capability classification, Limitations – Sub classes – Units.
28. Soil classification – Early system of soil classification
29. Diagnostic horizons – Epipedons and Endopedons,
30. Soil temperature regimes, Soil moisture regimes. Soil taxonomy – Order, sub order, great group and family series.
31. Nomenclature according to soil taxonomy, Salient features of soil orders.
32. Soil groups of India – Alluvial soils, black soils, red soils, laterite soils and coastal sands. Soils of Andhra Pradesh. Objectives of soil science research ICAR institutes in India (NBSS & LUP, CSSRI, IISWC) and objectives of ISSS, LTFE & NSSTL.

Practicals:

1. Collection and Preparation of Soil Samples.
2. Estimation of Moisture content in the given soil sample.
3. Estimation of pH and EC of the given soil sample
4. Estimation of Bulk density and pore space of soil
5. Textural analysis of the soil by Robinson's pipette method
6. Description of soil profile in the field.
7. Quantification of minerals and their abundance in soil
8. Determination of Soil colour using Munsell colour chart
9. Estimation of water holding capacity and Hydraulic conductivity of soils
10. Estimation of infiltration rate using double ring infiltrometer method
11. Estimation of soil moisture using gypsum block and neutron probe method
12. Determination of Field capacity and permanent wilting point of soil
13. Determination of soil water potential characteristic curves by tensiometer and pressure plate apparatus
14. Soil compaction measurement with penetrometer
15. Estimation of Aggregate size distribution analysis of soil
16. Estimation of Air capacity of soil by field capacity

References

- Brady Nyle C and Ray R Well. 2002. Nature and properties of soils. Pearson Education Inc., New Delhi.
- Indian Society of Soil Science. 1998. Fundamentals of Soil Science. IARI, New Delhi.
- Sehgal J.. A. Textbook of Pedology Concepts and Applications. Kalyani Publishers, New Delhi.
- Hillel D. 1982. Introduction to Soil Physics. Academic Press, London.

Course No.: ASMN-2.9.2

Course Title: Manures and fertilizers 2(2+0)

Lecture Outlines:

Theory

1. Introduction- Definition, difference between manures and fertilizers-Classification of manures (Bulky & Concentrated) with suitable examples.
2. Importance of manures and fertilizers in soil fertility management
3. Bulky & Concentrated organic manures
4. Preparation of FYM-Methods of collection and storage. Losses of nutrients from FYM during collection and storage-Ways to minimize these losses
5. Compost and composting -Different methods of composting including the starters and raw materials.
6. Details of methods of preparation of rural and urban compost. Mechanical compost plants
7. Vermicompost & Vermiwash - Earthworms, Preparation, advantages and application methods
8. Biogas plant - Principles of operation and its advantages.
9. Green manures -Classification with examples, Advantages and limitations of green manuring and green leaf manures
10. 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
11. Commercial fertilizers-Nitrogenous fertilizers, Manufacturing process and properties of nitrogenous fertilizers viz., Ammonia, Ammonium sulphate
12. Manufacturing process and properties of major nitrogenous fertilizers viz., Urea and Calcium ammonium nitrate. Slow releasing N Fertilizers
13. Phosphatic fertilizers Rock phosphate -Uses, Occurrence, types and properties.
14. Manufacturing process and properties of SSP, TSP and Basic slag
15. Potassic fertilizers -Mineral sources-Manufacturing process and properties of Muriate of Potash and Sulphate of Potash-
16. Mode of action of N, P and K fertilizers in soils
17. Secondary and micronutrient fertilizers -Conditions leading to their deficiency
18. Importance of use of different sources of secondary and micronutrient and their contents.
19. Mode of action of "S" fertilizers in soils
20. Compound and Complex fertilizers used in India- MAP, DAP, UAP, APS, APP and Nano fertilizers
21. Nitrophosphates and NPK Complexes- manufacturing process and properties.
22. Mixed and bulk blended fertilizers. Dry and wet process of mixing- advantages and Disadvantages of mixed fertilizers over straight fertilizers; Liquid formulations and micronutrient mixtures.
23. Physical and Chemical problems associated in Mixed and bulk blended fertilizers preparation. Compatibility of fertilizers.
24. Granulation, Unit value, grade and ratio of fertilizers, computation of fertilizer mixture. Combined application of fertilizers and Agricultural chemicals, Precautions and Compatibility.
25. Biofertilizer - Methods of preparation, Use of biofertilizers in agriculture, horticulture and sericulture.
26. Direct and Residual effects of fertilizers and Manures. Foliar nutrition of Crops- Importance and Limitations
27. Integrated Nutrient management (INM): For Agricultural and Horticultural crops –Need, components, Nutrient gains, constraints and Prospects of adopting INM.
28. Quality Control of Fertilizers FCO (1957)- its importance and regulations. Specifications and standards for important chemical fertilizers- Urea, SSP, MOP, DAP and Zinc Sulphate.
29. Sampling of organic manures and fertilizers for chemical analysis
30. Quick tests for identification of important fertilizers
31. Detection of adulteration in fertilizers
32. Fertilizer calculations for working out of quantities and dose of fertilizers for applications.

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Course No: VSMJ-2.2.1

Course Title: Commercial Vegetable Production 4(3+1)

Lecture Out lines

1. Olericulture-definition-Brief introduction to institutes working on vegetables at national and international level - Importance of vegetables: Economic, nutritional and medicinal importance of vegetables.

2. Vegetable Gardening: Types of vegetables Gardens – Kitchen Garden, market garden, Truck Garden, Vegetable Forcing, Garden for Processing, Seed production garden and Floating Garden.

3. Classification of vegetable crops:1)Botanical2)Based on hardiness3)Parts used4)Method of culture5)Season

4. **Tomato:** Introduction, Origin, Area and Production, Composition and uses, Pigmentation, Distribution and Export Potential of Tomato: Description of Cultivars -Production Technology – Soil and Climate, Seed Rate -Nursery techniques – Main field preparation -Application of Nutrients – Transplanting, spacing – Irrigation – Nutrition – Fertilizers, inter cultivation operations, Weed Control ,Mulching.

5. Effect of Chemicals & Growth Substances on various growth and yield Parameters, stages of maturity, Harvesting and Yield – Grading (4Grades-Super A, Super, Fancy & Commercial), Post Harvest Handling and Storage. Physiological Disorders.

6. **Brinjal:** Introduction, Origin, Area and Production, nutritional Composition, Flower types based on Style Length-cultivars. Production Technology – Soil and Climate; Cultivation; Seed Rate, Seed Treatment and Raising of Nursery, Land Preparation, Transplanting, spacing, Irrigation, Manures and fertilizers-inter culture in Brinjal. Effect of Growth Substances on Fruit set, Harvest Indices; Yield, Grading and storage. Physiological disorders.

7. **Chilli:** Introduction, Origin, Area and Production, Composition and Uses of chilli and bell pepper-Pigmentation and Pungency, Distribution and Export Potential of Chilli-Taxonomy-Cultivars. Production Technology – Soil and Climate-Methods of raising the crop-Nursery Vs. Direct Sowing, Seed Rate-nursery techniques-Main field preparation-Spacing-Irrigation-nutrition-Fertilizers. Effect of Growth Substances on Flowering, fruit set and fruit Maturity: Stage of maturity for harvesting – For Green Chilli and Dry Chilli, Harvesting and yield drying and Storage; Value Addition & Economics. Physiological disorders.

8. **Okra:** Introduction, Origin, Area and Production, nutritional composition and uses-Distribution and Export Potential of Okra-cultivars. Production Technology – Soil & climate; cultivation; land preparation, sowing season, seed rate, spacing, nutrition, irrigation and inter culture. Use of growth substances-stage of harvest, harvesting & yield, storage; economics and value addition.

9. **Cucurbits:** Introduction, Area and Production, Origin and distribution, composition and uses, characteristics of cucurbitaceous family-list of cultivated cucurbits (Botanical Names & common names) Bitter Principle-Flowering, Sex mechanisms sex expression-use of Plant Growth Regulators for Sex modification. Physiological disorders .

10. **Cucurbits:** Cultivation details (**Cucumber, bottle gourd and bitter gourd**),soil and climate-cultivars-propagation and planting methods –seed rate, spacing, irrigation, nutrient management – inter culture–Weed control, Mulching, plant growth regulators – maturity indices –harvesting and yield.

11. **Cucurbits**: Cultivation details of gourds (**Ridge gourd, ash gourd and snake gourd**) Production technology – soil and climate – cultivars – propagation and planting methods – seed rate, spacing, irrigation, nutrient management – Inter culture – Weed Control, Mulching, plant growth regulators – maturity indices – harvesting and yield.

12. **Cucurbits:** Cultivation details of **melons(water melon & musk melon)**- Production technology – soil and climate – cultivars – propagation and planting methods – seed rate, spacing, irrigation, nutrient management – Inter culture – Weed Control, Mulching, plant growth regulators – maturity indices – harvesting and yield – Production of seedless watermelons.

13. **Cucurbits:** Cultivation details of **Coccinia & Pointed gourd**-Production technology – soil and climate – cultivars – propagation and planting methods –spacing, irrigation, nutrient management – Inter culture – Weed Control, Mulching, plant growth regulators – maturity indices – harvesting and yield.

14. **Cucurbits:** –Cultivation details of **Spine gourd, Sweet gourd and Chow chow** Production technology – soil and climate – cultivars – propagation and planting methods –spacing, irrigation, nutrient management – Inter culture – Weed Control, Mulching, plant growth regulators – maturity indices – harvesting and yield.

15. **Cucurbits:** –Cultivation details of **Pumpkin & Squashes**-Production technology – soil and climate – cultivars – propagation and planting methods –spacing, irrigation, nutrient management – Inter culture – Weed Control, Mulching, plant growth regulators – maturity indices – harvesting and yield.

16. **Cabbage:** Introduction, Origin, Area and Production, nutritional value, bitter principle, Distribution and Export Potential- Cultivars- classification based on shape, colour and crop duration. Production Technology – Soil and climate requirements. Nursery techniques – Seed Rate and nursery sowing. Main field preparation, Transplanting, Spacing, - Irrigation – Nutrition – Inter cultivation – Stage of maturity – method of harvesting and Yield – Post Harvest Handling and Storage- Physiological disorders.

17. **Cauliflower:** Introduction, Origin, Area and Production, nutritional value – Distribution and Export potential – Cultivars- types and classification – Production Technology – Soil and climate- Seed Rate and nursery sowing – Transplanting, Spacing and Irrigation- Nutrition – Deficiency symptoms of Nutrients. Inter cultivation and blanching- Stage of maturity, Harvesting and Yield – post Harvest, Handling and Storage- Physiological disorders .

18. **Knol – Khol:** Introduction, Origin, Area and Production, nutritional value- Cultivars – Production Technology – Soil and climate- Seed Rate and sowing. Transplanting, spacing and Irrigation – Nutrition – Inter cultivation- Harvesting and Yield – Post harvest handling and Storage. Physiological disorders.

19. **Brussels Sprouts and Sprouting Broccoli** : Introduction, Origin, Area and Production, nutritional composition and Uses – Cultivars – Production Technology – Soil and climate – Seed Rate and sowing – Transplanting, Spacing, - Irrigation – Nutrient management – Inter cultivation – Harvesting and Yield – Post Harvest Handling and Storage. Physiological disorders.
20. **Chinese Cabbage** (Botanical Name): Introduction, Origin, Area and Production, nutritional value- Cultivars – Production Technology – Soil and climate- Seed Rate and sowing. Transplanting, spacing and Irrigation – Nutrition – Inter cultivation- Harvesting and Yield – Post harvest handling and Storage. Physiological disorders

21. **Onion**: Introduction, Origin, history, Area, production and productivity – Distribution and Export Potential – nutritional value and pungency principle – Cultivars – Production Technology – Soil and climate requirements. Propagation and planting methods – seed Rate and sowing. Main field preparation – Transplanting, Spacing, - Irrigation - Nutrition – Deficiency symptoms of nutrients – Inter cultivation – stage of maturity, Harvesting, curing and Yield – Post Harvest Handling and Storage – Physiological disorders.

22. **Garlic:** Introduction, Origin, Area and Production, nutritional value- Cultivars – Production Technology – Soil and climate- Seed Rate and sowing. Spacing and Irrigation – Nutrition – Inter cultivation- Harvesting and Yield – Post harvest handling and Storage. Physiological disorders

23. **French Bean and Lab-Lab (Dolichos) bean:** Introduction, Origin, Area, Nutritive composition – Classification: According to Habit (pole, semi pole and bush types) – Production Technology: Climate and Soil-cultivars-Season-Seed Rate, Seed Inoculation, Spacing, Nutrition, Irrigation and Inter-cultivation; maturity standards, Harvesting, Yield, Storage & Economics. Physiological disorders.

24. **Cluster Bean and Vegetable Cow pea:** Introduction, Origin, Area, Nutritive value Production Technology – climate and soil; seed rate , sowing, spacing, nutrition, irrigation-stage of harvest based on the purposes, yield and storage and economics. Physiological disorders.

25. **Pea**: Introduction, Origin and taxonomy – Area, Production and productivity – nutritional value-botany – distinguishing characters – Cultivars classification of cultivars based on seed texture, height of plant, maturity and use of pods. Production Technology – Soil and climate – seed rate, sowing and spacing, Irrigation – Nutrition – Inter culture- Plant growth regulators-Harvesting and Yield – Post Harvest Handling and Storage. Physiological disorders.

26. **Broad bean and vegetable pigeon pea**: Introduction, Origin, Area, Production and productivity – nutritional value – Cultivars – Production Technology – Soil and climate – seed rate, sowing and spacing, Irrigation – Nutrition – Inter culture- Harvesting and Yield – Post Harvest Handling and Storage. Physiological disorders.

27. **Potato:** Introduction, Origin, Area, Production, Productivity, history and distribution – role in Indian economy- importance and nutritional value- Cultivars- potato zones.Soil and climate – Propagation and planting material True potato seed(TPS).

28. **Potato:**Seed plot technique– seed rate – Main field preparation, sowing/planting and spacing – Irrigation – Nutrition – Inter culture.Harvesting, curing and Yield – Post Harvest Handling and Storage- Physiological disorders of potato.

29. **Sweet potato**: Introduction, Origin, area and production- nutritional value – Cultivars – Soil and climate – propagation and planting- seed rate and spacing, - Irrigation – Nutrition – Inter culture(turning of vines)- Harvesting, curing and yield – Post harvest handling and Storage. Physiological disorders.

30. **Tapioca/Cassava**: Introduction, origin, area and production – nutritional value and toxic principle – Cultivars Soil and climate – Propagation and planting material – seed rate and spacing, -Irrigation – Nutrition – Inter culture – Harvesting, Yield and storage. Physiological disorders.

31. **Yams**: Introduction, Origin, area and production – nutritional value and uses – alkaloids – types of Yams – Cultivars – Production Technology – Soil and climate – propagation and planting material – seed rate and spacing, Irrigation – Nutrient management – Inter culture (training of vines – Harvesting, Yield and storage. Physiological disorders.

32. **Colocasia / Taro** (Botanical Name): Introduction, Origin, area and production nutritional value – acridity principle – Cultivars – Production Technology – Soil and climate- propagation and planting material – seed rate and spacing, - Irrigation- Nutrition – Inter culture – Harvesting, curing, yield and storage. Physiological disorders.

33. **Elephant foot Yam** (Amorphophallus): Introduction, Origin, area and production – nutritional value – acridity principle – Cultivars – production Technology – Soil and climate – propagation and planting material – seed rate and spacing, - Irrigation – Nutrition – Inter culture – Harvesting, curing, yield and storage. Physiological disorders.

34. **Carrot**: Introduction, Origin, Area, Production and productivity – nutritional value – pungency and pigmentation – Cultivars- classification of cultivars based on root shape and temperature response to flowering (Asiatic and European) – Production Technology – Soil and climate – seed rate, sowing and spacing, - Irrigation - - Nutrition – Inter culture – Harvesting and Yield – Post Harvest Handling and Storage. Physiological disorders

35. **Radish& Turnip**: Introduction Origin, Area, Production and productivity – nutritional value-pungency and pigmentation – Cultivars – Asiatic and European types – production Technology – Soil and climate – seed rate, sowing and spacing, - Irrigation – Nutrition – Inter culture – Harvesting and Yield – Post Harvest Handling and storage. Physiological disorders.

36. **Beet root**: Introduction, Origin, Area, Production and productivity – nutritional value – pigmentation – Cultivars –Production Technology – soil and climate – seed rate, sowing and spacing, - Irrigation, - Irrigation – Nutrition – Inter culture – Harvesting and Yield – Post Harvest Handling and Storage. Physiological disorders.

37. **Drumstick:** Introduction, Origin, Composition of Pods, Leaves and uses of Moringa-cultivars. Production technology: Soil and climate; Propagation and planting methods-seed rate – field preparation-sowing/planting-nutrition, Irrigation and inter culture; pruning for extension of cropping season- harvesting and yield.

38. **Curry Leaf:** Introduction, Origin Area and Nutritive value cultivars soil & climate, cultivation - land preparation, nursery raising-sowing/Planting, seed rate, spacing, Irrigation, nutrition – harvesting and yield.

39. **Amaranthus:** Introduction, Origin, Area, Nutritive value –cultivars-soil & climate land preparation, sowing seed rate, spacing, irrigation and nutrition – methods of harvesting and yield.

40. **Palak/Spinach beet and Spinach:** Introduction, Origin, nutritional value- botany and cultivars – differentiation with spinach – Production Technology – Soil and climate – seed rate, sowing and spacing – Irrigation – Nutrition – Inter culture- Harvesting, yield and storage.

41. **Methi (Fenugreek) and Coriander:** Introduction, Origin, nutritional value – botany- Cultivars – classification of cultivars based on seed type and leaf type- production Technology – Soil and climate – seed rate, sowing and spacing, Irrigation- Nutrition – Inter culture – Stage of maturity-Harvesting, Yield and storage.

42. **Roselle & Sorrel :** : Introduction, Origin, Area, Production and productivity — Cultivars – Production Technology – Soil and climate – seed rate, sowing and spacing, Irrigation – Nutrition – Inter culture- Harvesting and Yield – Post Harvest Handling and Storage.

43. **Basella and Bathua:** Introduction, Origin, Area and Nutritive value –cultivars (Reddish stem type & commonly grown green types)-Soil and Climate; Propagation – Seed, stem cuttings, crop duration-seed rate, spacing, nutrition, and irrigation – harvesting and yield.

44. **Lettuce & Celery**: Introduction, Origin, importance and nutritional value – Cultivars – types of lettuce – Production Technology – Soil and climate – seed rate, sowing/ planting – spacing, Irrigation – Nutrition – Inter cultivation – Harvesting and Yield – Post Harvest Handling and Storage.

45-46: Speciality vegetables: Introduction-nutritional value - cultivars-Economic importance-Brief cultural practices of Asparagus, Rhubarb, Globe artichoke

47-48: Speciality vegetables: Introduction-nutritional value - cultivars-Economic importance-Brief cultural practices of Jerusalem artichoke and West Indian Arrow root

Practicals:

1. Identification of vegetable crops based on botanical classification.
2. Nursery techniques for vegetable production and Hi-tech vegetable nursery production.
3. Planning and layout of a kitchen garden
4. Methods of main field preparation and transplanting of nursery grown seedlings
5. Inter cultural and special cultural operations in vegetable plots.
6. Plant growth regulators in vegetable production
7. Nutritional deficiencies and physiological disorders of vegetable crops.
8. Harvesting indices and maturity standards of vegetables.
9. Post harvest handling of vegetables
10. Seed extraction methods of vegetable crops
11. Harvesting and curing techniques for potato and other tuber crops.
12. Identification and description of commercially important varieties of vegetable crops.
13. Identification and description of commercially important varieties of Tuber crops.
14. Identification of seeds of commercially important vegetable crops
15. Visit to vegetable research station.
16. Visit to farmer's field

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Course No.: VSMJ-2.2.2

Course Title: Seed Production of Vegetable, Tuber and Spice Crops-3(2+1)

Lecture outline
Theory:

1. Introduction and history of seed industry in India-concept of seed technology-seed quality-definitions of seed technology-objectives/goals of seed technology-importance of seed production
2. Definitions of seed, classes -types of seed, differences between grain and seed.
3. Importance and scope of vegetable seed production in India and SWOT analysis of Indian seed industry.
4. Genetic and Agronomic principles of vegetable seed production. Role of temperature, humidity, and light in vegetable seed production
5. Seed legislations-Seed Act and Seed Act enforcement – main features of the Seed Act 1966 – Central Seeds Committee –Central Seed Certification Board – State Seed Certification Agency – Seed testing – objectives of seed testing – International Seed Testing Association (ISTA)-Central and state Seed Testing Laboratory –Appellate Authority – recognition of Seed certification Agencies of foreign countries – notification of standards and procedures.
6. Seed certification – history of seed certification – procedure for seed certification -duties and powers of seed inspectors – offenses of Seed Act and penalties.
7. Seed extraction-methods of seed extraction in different Vegetable crops.
8. Seed drying – methods of seed drying – sun drying – forced air drying – principle of forced air drying –heated air-drying system – types of air distribution system and seed drying – multiple

bin storages – selection of crop dryers and systems of heated air drying – recommended temperature and depth for heated air drying of various crop seeds in bin – management of seed drying operations

9. Seed cleaning – principle and method of cleaning seeds – air screen machine – principle of cleaning – parts of air screen cleaner **-** upgrading the quality of cleaned seeds – different upgrading machines, their principles of operation and uses.
10. Seed treatment and – benefits – types of seed treatment – conditions under which seed must be treated – seed treating products – equipment used for seed treatment – colouring of seeds – causes of poor treatments – precautions to be taken during seed treatment
11. Seed packaging – operations in packaging – equipments used for packaging of seeds –types of bags and packing sizes.
12. Seed storage – categories of seeds – orthodox and recalcitrant seeds – factors affecting seed longevity in storage and conditions required for good storage – general principles of seed storage.
13. Seed marketing – marketing structure and organization.
14. Seed priming, pelleting, field and seed standards.
15. Seed germination and purity analysis methods in different horticultural crops.
16. Seed dormancy – seed germination – seed viability – seed vigour – seed health and seed moisture.
17. Varietal identification through Grow out Test (GOT) and electrophoresis.
18. Land requirements, climate, season, planting time, nursery management, seed rate, rouging, seed extraction and storage, packaging and labelling of **tomato** seed production
19. Land requirements, climate, season, planting time, nursery management, seed rate, rouging, seed extraction and storage, packaging and labelling of **brinjal** seed production
20. Land requirements, climate, season, planting time, nursery management, seed rate, rouging, seed extraction and storage, packaging and labelling of **chilli** and **capsicum** seed production
21. Land requirements, climate, season, planting time, nursery management, seed rate, rouging, seed extraction and storage, packaging and labelling of **okra** seed production
22. Land requirements, climate, season, planting time, nursery management, seed rate, rouging, seed extraction and storage, packaging and labelling of **cucumbe**r seed production
23. Land requirements, climate, season, planting time, nursery management, seed rate, rouging, seed extraction and storage, packaging and labelling of **muskmelon** and **watermelon** seed production
24. Land requirements, climate, season, planting time, nursery management, seed rate, rouging, seed extraction and storage, packaging and labelling of **ridge gourd** and **bottle gourd** seed production
25. Land requirements, climate, season, planting time, nursery management, seed rate, rouging, seed extraction and storage, packaging and labelling of **leafy vegetables (Amaranthus-Palak-Spinach-Coriander-Fenugreek**) seed production
26. Land requirements, climate, season, planting time, nursery management, seed rate, rouging, seed extraction and storage, packaging and labelling of **onion s**eed production
27. Land requirements, climate, season, planting time, nursery management, seed rate, rouging, seed extraction and storage, packaging and labelling of **leguminous crops** seed production

28. Land requirements, climate, season, planting time, nursery management, seed rate, rouging, seed extraction and storage, packaging and labelling of **exotic vegetable (Broccoli, Lettuce and Asparagus)** seed production
29. Land requirements, climate, season, planting time, nursery management, seed rate, rouging, seed extraction and storage, packaging and labelling of **cabbage and cauliflower** seed production.
30. Land requirements, climate, season, planting time, nursery management, seed rate, rouging, seed extraction and storage, packaging and labelling of **root crops** seed production
31. Land requirements, climate, season, planting time, nursery management, seed rate, rouging, seed extraction and storage, packaging and labelling **of potato** crop seed production
32. Land requirements, climate, season, planting time, nursery management, seed rate, rouging, seed extraction and storage, packaging and labelling of **turmeric** and **ginger** crops seed production.

Practical's:

1. Study of seed structure, texture, colour, shape and size.
2. Purity analysis in different vegetable crops.
3. Germination, viability, and vigour tests in different vegetable crops.
4. Practices in rouging during seed production
5. Seed certification procedure in different vegetable crops.
6. Study of seed production and certification in tomato and brinjal
7. Study of seed production and certification in chilli and capsicum
8. Study of seed production and certification in okra
9. Study of seed production and certification in onion
10. Study of seed production and certification in cucumber
11. Study of seed production and certification in legume crops
12. Study of seed production and certification in cole crops
13. Study of seed production and certification in root crops
14. Study of seed production and certification in coriander and fenugreek
15. Study of seed processing machines
16. Visit to seed production units.

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- Thomson, J.R. (1979). Leonard Hill, London An introduction of seed technology

Course No.: ASMN-2.9.3

Course Title: Introductory Agro meteorology and Climate change-2 (1+1)

Lecture Outlines:

Theory:

1. Meteorology - introduction - definitions of meteorology, climatology and agricultural meteorology - scope and practical utility of agricultural meteorology
2. Composition and structure of atmosphere - definitions of weather and climate -aspects involved in weather and climate
3. Air temperature - introduction - temperature and heat definitions - isotherms - horizontal and vertical temperature variations in the atmosphere - cardinal temperatures
4. Importance of air temperature in crop production - Low air temperature and plant injury – high air temperature and plant injury – soil temperature – factors affecting soil temperature

5. Solar radiation - definition, introduction of electromagnetic spectrum and functions of light, solar constant, net radiation, black body radiation, emissivity, absorptivity, reflectivity, transmissivity and albedo
6. Physiological response of different bands of incident radiation - factors affecting distribution of solar radiation within the plant canopy - Definitions of atmospheric pressure, cyclones – anticyclones – pressure patterns
7. Wind and humidity – effects of wind on crops – mountain and valley winds – land and sea breezes - Atmospheric humidity and its expression - saturation - effects of humidity on crops
8. Evaporation and transpiration - definition - factors affecting rates of evaporation and transpiration
9. Rainfall - importance of rainfall on crops - types of rainfall - monsoon - definition - origin and distribution of south west monsoon and North East monsoons– their impact on farm operations
10. Condensation and precipitation - definition, different forms of condensations and precipitations
11. Clouds - cloud formation - cloud classification and characteristics - World Meteorological Organization (WMO) - cloud seeding (artificial rain making)
12. Drought - definition - types of drought - effect of drought on crops - management of drought
13. Weather disasters and management - rainfall, heat and cold waves, windstorms, hail storms, thunderstorms, dust storms, tornadoes and defective insolation
14. Modifications of micro climate – climatic normal for crop and livestock production

15. Weather forecasting - applications and utility for agriculture - synoptic charts, reports and symbols - Remote sensing - definition - introduction - applications in Horticulture
16. Climate change: causes – Global warming – Effect of climate change on horticulture – past and future changes in green house gases with in the atmosphere – sources and sinks for green house gases- Mitigation strategies

Practicals:

1. Site selection for agromet observatory
2. Layout plan of standard meteorological observatory
3. Calculation of time
4. Measurement of temperature (air/soil)

5 & 6. Study of types of rain-gauges-Measurement of rainfall - tabulation and critical analysis of rainfall

7. Computation of drought indices, PET and AET
8. Measurement of evaporation (atmospheric/soil)
9. Measurement of atmospheric pressure
10. Measurement of sunshine duration
11. Measurement of wind direction and speed
12. Measurement of relative humidity
13. Measurement of radiation and its components
14. Study of weather forecasting, synoptic charts, weather reports and symbols
15. Study of meteorological periods and weeks and tabulation of weather data
16. Visit to Agromet observatory

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Course No.: ESMD-2.11.1

Course Title: Agricultural Marketing and Trade -3(2+1)

Lecture Outlines:

Theory

1.	Agricultural Marketing: Concepts, importance and definitions- market, marketing, agricultural marketing, marketing mix and market segmentation
2.	Classification and characteristics of agricultural markets
3.	Nature and determinants of demand and supply of farm products
4.	Producer surplus - Meaning and its types, marketable surplus and marketed surplus and factors affecting marketable surplus of agricultural commodities
5.	Market structure-Perfect competition and characteristics
6.	Imperfect competition-Characteristics-Types-monopoly, oligopoly and monopolistic competition.
7-8	Marketing process - concentration, dispersion and equalisation- Marketing functions-exchange functions – buying and selling; physical functions – storage, transport and processing; facilitating functions – packaging, branding, grading, quality control and labelling (AGMARK)
9-10	Market functionaries - Types and importance of agencies involved in agricultural marketing and their role.
11-12	Marketing channels-Meaning and definition-Importance in horticultural marketing-Number of channel levels-Marketing channels for different farm products

13-14 Marketing costs, margins and price spread -Meaning and measurement, factors affecting marketing costs and ways of reducing marketing costs.

15-16 Pricing and promotion strategies: Pricing considerations and approaches – cost based and competition based pricing

17 Market promotion – advertising, personal selling, sales promotion and publicity – merits and demerits.

18-19 Market integration – Meaning, Definition and types- Marketing Efficiency – Meaning - Types and its measurement.

20-21 Risk in marketing: Types of risk in marketing; Speculation and hedging - Forward and Future trading: an overview

22 Regulated markets -Definition & Objectives- Important features and functions.

23-24 Cooperative marketing in India-Concept, importance- NAFED-Objectives-Functions-Role of Government in agricultural marketing in India – Role of APMC and its relevance in the present-day context-Public sector institutions-CWC, SWC, FCI, & DMI – objectives and functions

25-26 Need for agricultural price policy - Role of Commission for Agricultural Costs and Prices (CACP) - Administered prices - Minimum support price, procurement price, issue price and levy price.

27-28 Digital marketing – introduction, tools and its utilization in agricultural marketing. e-NAM- objectives and its importance.

29. Concept of international trade, and its importance- Basic terms and concepts - Terms of Trade, tariffs, import quotas, foreign exchange rate, exchange control, dumping, anti-dumping, balance of trade and balance of payments.

30. Theories of absolute advantage and comparative advantage.

31. WTO -objectives, Agreement on Agriculture (AOA) - market access, export subsidies and domestic support.

32. Sanitary and Phyto-sanitary measures, Technical Barriers to Trade and Intellectual Property Rights.

Practical

1 Identification of problems in marketing of important agricultural/horticultural commodities in India and suggestions for improvement

2 Pricing strategies for major horticultural commodities

3 Study of relationship between market arrivals and prices of major horticultural commodities

4 Identification of various market structures for different commodities

5 Computation of marketed surplus and marketable surplus for various commodities

6 Study of price behaviour over time for selected commodities

7 Construction of index numbers

8 Identification of marketing channels for various agricultural or horticultural commodities

9 Estimation of marketing costs, marketing margins and price spread of important horticultural commodities

10 Empirical assessment of marketing efficiency of different horticultural commodities in India

11 Visit to local market to study marketing functions performed by different agents

12 Visit to CWC/SWC/FCI/NAFED

13 Study of a regulated market

14-15 Study of different digital marketing tools

16 Study of comparative advantage of different commodities of India in international trade

References

- Acharya, S.S. and Agarwal, N.L., 2006, Agricultural Marketing in India, Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi.
- Chinna, S.S., 2005, Agricultural Economics and Indian Agriculture. Kalyani Pub, N Delhi.
- Kohls Richard, L. and Uhl Josheph, N., 2002, Marketing of Agricultural Products, Prentice-Hall of India Private Ltd., New Delhi.
- Kotler,P and Keller, K.L.2015. Marketing management. Pearson International Publications.
- Kotler and Armstrong, 2005, Principles of Marketing, Pearson Prentice-Hall.
- Lekhi, R. K. and Jogindr Singh, 2006, Agricultural Economics. Kalyani Publishers, Delhi.
- Memoria, C.B., Joshi, R.L. and Mulla, N.I., 2003, Principles and Practice of Marketing in India, Kitab Mahal, New Delhi.
- Pandey Mukesh and Tewari, Deepali, 2004, Rural and Agricultural Marketing, International Book Distributing Co. Ltd, New Delhi.
- Sharma, R., 2005, Export Management, Laxmi Narain Agarwal, Agra.

Course No. : PTMJ-2.7.1

Course Title: Fundamentals of Plant Pathology -3(2+1)

Lecture Outline:

Theory

1-3- Introduction to Plant Pathology – Definition and objectives of Plant Pathology – Different kinds of Plant Pathogens *viz*., fungi, bacteria, viruses, viroids, fastidious vascular bacteria, Phytoplasmas, algae, protozoa- Economic importance of plant diseases in terms of losses and socio-economic changes specifying plant disease epiphytotics (late blight of potato, brown spot of rice, coffee rust, southern corn blight, Sigatoka leaf spot in banana, Panama wilt in banana (TR4), Groundnut stem necrosis disease- (Tobacco streak virus) *etc*.,). History of plant pathology - contributions of Micheli, Tillet, Prevost, Persoon, Fries, Anton de Bary and his students (Woronin, Brefeld, Millardet, Marshal ward) Mundkur, Tirumalachar, Subramanian, K C Mehta, *etc.*

4-6 Terms and concepts used in Plant Pathology – disease, disorder, pathogen, parasite, pathogenicity, casual organism, pathogenesis, sign, symptom, syndrome, biotrophs, hemibiotrophs/ necrotrophs, inoculum, inoculum potential, Inoculum density, infection, incubation period, pre-disposition, hypersensitivity, disease triangle and disease pyramid. Cross protection, suppressive soils. Classification of plant diseases based on cause (parasitic and non-parasitic diseases), occurrence (endemic, epidemic, sporadic and pandemic) and symptoms [(necrotic, over growth (hyperplastic and hypertrophic) and under growth (Hypotrophic and hypoplastic diseases)].

7-9 Parasitic causes of plant diseases – Fungi – Classification (according to Kirk *et al*., 2008) of fungi upto sub phyllum-Distinguishing characters of each Kingdom upto phyla with important examples of plant pathogenic fungi.

10- 12 History of plant bacteriology – Contributions of T J Burrill, E F Smith and M K Patel. Classification of phytopathogenic bacteria (BMSB, 1984), General characteristics of plant pathogenic bacteria, important characteristics of individual genera *viz.*, *Pseudomonas, Xanthomonas, Agrobacterium, Erwinia*, *Clavibacter, Streptomyces* and their diseases — History of plant virology – contributions of Adolf Mayer, Iwanowski, Beijerink, Stanley and Bawden & Pierie. General characters of plant viruses – classification of plant viruses based on NA and shape with examples. Disease symptoms (mosaic, mottle, streaks or stripes, yellows, chlorosis, chlorotic rings, vein clearing and banding, reddening, Bronzing, shoe-string leaves, leaf curling and enations) – transmission of viruses-artificial and natural transmission, Modes

of transmission– contributions of Diener – study of viroids – important characters and diseases caused by them.

13- 15 History of phytoplasmas – contributions of Doi *et al.* and Ishiie *et al.*. General characters of phytoplasmas, common disease (aster yellows, sesamum phyllody, potato witches broom, little leaf of brinjal., *etc*) and transmission –Fastidious vascular bacteria (FVB) – important characters of fastidious vascular bacteria – examples of diseases caused by phloem limited and xylem limited fastidious vascular bacteria. Trypanosomatid flagellates (flagellated protozoans). Important characters. *Phytomonas* sp. and disease caused by them. Algae – Important characters. *Cephaleuros* sp and diseases caused by them. Flowering parasites, classification and important characters partial and complete parasites.

16-17 Environmental factors that cause plant diseases (non-parasitic causes) light, low temp, drought, mineral deficiency (Fe, Mg, Ca, Zn), PAN, Herbicide / Pesticide injury with examples of diseases.

18. Survival of plant pathogens – Kinds of inoculum produced by different plant pathogens with examples. Pattern of survival
    a) infected host (main host, alternate host, collateral host)
    b) saprophytic survival outside the host (soil and root inhabitants, rhizosphere colonizers)
    c) dormant spores' structures (seed borne, soil borne, and infected plant debris)

19. Dispersal of plant pathogens.
    a) Autonomous dispersal (soil, seed, plant parts and plant organs)
    b) Passive dispersal *viz.,* water, members of animal kingdom (man, insects, nematodes, animals and birds), fungi and phanerogams.

20-21 Phenomenon of infection – process of infection – pre-penetration and post penetration – pre-penetration in fungi (spore germination, germ tube, formation of specialized structures like appressorium, haustoria, rhizomorphs), bacteria and viruses-indirect penetration through wounds or natural openings like stomata, hydathodes and lenticels.

22-23 Direct penetration through plant surface (epidermis or cuticle) by chemical or mechanical means. Role of toxins and enzymes in plant pathogenesis. Plant defence mechanisms in plant-pathogen interactions. Post penetration – colonization of the host.

24,25 Plant disease epidemiology – meaning and importance – difference between compound and simple interest diseases. Factors affecting plant disease epidemics-Advantages of diseases fore casting. Measurement of plant disease with examples of systemic disease and foliar diseases (loose smut of the wheat and Alteranaria leaf spot of tomato)

26-32 Principles and methods of plant disease management

1.Exclusion –Plant quarantine with examples, Phytosanitary certificate

2. Avoidance of the pathogen (selection of pathogen free material and seed, selection of field, choice of time of sowing, disease escaping varieties)

3. Eradication- (a) Cultural practices (b) Biological control (important fungal and bacterial bio control agents (c) physical methods (soil solarization and hot water treatment).

4.Protection-classification of fungicides Based on chemical nature (commonly used fungicides, bactericides and nematicides), mode of action and general use

5. Host plant resistance (immunization)-definition –Types of resistance– importance and advantages of resistant varieties.

PRACTICALS:

1. Familiarity with general plant pathological laboratory equipment and safety rules.
2. Preparation of culture media for fungi (PDA) and bacteria (NA).
3. Isolation of fungal and bacterial plant pathogens.
4 and 5. Study of Chromista/ Straminophila
6. Study of Zygomycota fungi
7. Study of Ascomycota fungi
8. Study of Basidiomycota fungi
9. Micrometry and phytopathometry

10-11. Field visit: Study of diseases symptoms and signs of important horticultural crops, phanerogamic parasites, non-parasitic diseases.

12. Preparation of fungicides – Bordeaux mixture, Chaubattia paste, Cheshnut compound and

calculations.

13. Study of non-systemic and systemic group of fungicides and calculations related to fungicide concentrations (Copper, Sulphur, Heterocyclic – nitrogenous compounds, other systemic fungicides *etc*.,)
14. Demonstration of virus transmission (Mechanical/sap transmission)
15-16. Methods of application of fungicides, demonstration of seed treatment, soil application, foliar spray and post-harvest treatment of fruits.

References

- Agrios, G. N., 2006, Plant Pathology, Fourth Edition, Academic press, New York, 996pp.
- Mehrotra, R.S and Ashok Agarwal, 2003, Plant Pathology, Tata McGraw- Hill publishing Company ltd., New Delhi.
- Singh, R. S., 2002, Introduction to Principles of Plant Pathology, Fourth Edition, Oxford and IBH, Publishers Co. Pvt. Ltd., New Delhi.
- Tripathi, D.P 2014, Introductory Plant Pathology, Kalyani publishers, 380 pp.

Course No. : ESNG-2.11.1

Course Title: ELEMENTARY MATHEMATICS : (0+1)(Non Gradial)

Lecture Outlines:

S.No.	Practical
1	Problems in Linear equations
2	Problems in Quadratic equations
3	Problems in Arithmetic progression
4	Problems in Geometric Progression
5	Problems in Matrix addition and multiplication
6	Problems in matrix determinants
7	Problems in matrix inverse
8	Problems in matrix inverse by Cramer's Rule
9	Problems in differentiation by standard rules, product and quotient rules
10	Problems in differentiation of the function of function, logarithmic functions
11	Problems in Integration by substitution method and method of $\int (f(x))^n f'(x)dx,$
12	Problems in integration in the form $\int \frac{f'(x)}{f(x)} dx$, Integration by parts
13	Problems in straight-line (general form, Slope point)
14	Problems in straight-line (two-point form, intercept form)
15	Problems in Circle
16	Problems in parabola

References

- Prof. Romesh Chander – Elementary Mathematics-New Academic Publishing Co., Mai Hiran Gate, Jalandar
- G. S. Monga –Mathematics and Statistics for Economics- Vikas Publishing House Pvt. Ltd.
- R. C. Joshi – Business Mathematics- New Academic Publishing Co., Mai Hiran Gate, Jalandar

Course No. : PHNG-2.5.1

Course Title: Fundamentals of Food and Nutrition -2(2+0) (Non Gradial)

Lecture Outlines:

S.No	CONTENTS
1.	Food -its importance for health, Definition of food, Definition of Health, Food science, Food technology, abbreviations, Institutes and their headquarters.
2-3.	Functions of Food-Physiological Functions (Energy giving, body building and Regulation of Body Processes and Body protection), Psychological Functions and Social Functions, Food grouping (Basic IV, V,VII) and classification of food based on nutritional contribution and Food guide pyramid.
4.	Physico-chemical properties of foods (Organic compounds: Colloids, crystalloids, osmotic pressure, emulsions.)
5-6.	Introduction to nutrition-Definition of Nutrition, History of Nutrition-Relationship of nutrition to health
7-8.	Energy, definition, determination of energy requirements, food energy, Energy balance, total energy needs of the body, Basal metabolism
8-9.	Carbohydrates; Definition, Structure and general properties of: Mono saccharides-Glucose, Fructose, Galactose, Ribose. Disaccharides – Maltose, Lactose, Sucrose. Polysaccharides – Dextrin, Starch, Glycogen.
10-11.	Protein - Functions, sources and requirements, utilization, Protein quality – PER, BV, NPU, digestibility coefficient. Essential amino acids, their importance.
12-13.	Fats and Lipids – Classification of Fatty acids, functions, sources, requirement, importance of essential fatty acids, their requirements and deficiency.
14-15.	Mineral nutrition- Macro & Micro minerals, functions, utilization, requirements, sources, effects of deficiency, Calcium & phosphorus - functions, absorption &utilization of iron, deficiency and toxicity.
16-17.	Mineral nutrition- micro minerals, functions, utilization, requirements, sources, effects of efficiency, Iron, Fluorine, Zinc, copper, Iodine -functions, absorption, utilization, requirements, deficiency and toxicity.
18.	Vitamins: Functions, sources, requirements, effects of deficiency, deficiency disorders of Fat soluble vitamins –A, D, E and K-,. Water soluble vitamins –The B-complex vitamins – Thiamine, Riboflavin, Niacin, Folic acid, Biotin, Pantothenic acid, B12 and Vitamin C
19.	Balanced diet- Definition, objectives and food selection
20.	Recommended dietary allowances for various age groups, Assessment of nutritional status of the population
21.	Functional foods and Nutraceuticals- Definition, sources, Health benefits.
22.	Food sanitation and Hygiene in food preparation, Food safety, Risks and hazards: Food related hazards, Microbial consideration in food safety, HACCP-principles and structured approach. FSSAI
23.	Food additives- Preservatives, colouring, flavouring, sequestering agents, emulsifiers, antioxidants *etc*.

24. Basal metabolic rate-definition, factors influencing BMR.

25. Nutrient loss during cooking. Sensory evaluation of foods, types of tests used for sensory evaluation.

26. Fruits and vegetables- composition, nutritive value, sources, effect of cooking on plant pigments and cooking methods. Composition and nutritive value of oilseeds, spices, condiments, tea, coffee, cocoa, nuts.

27. Principles of quality control of foods- Raw material control, processed food control and finished product inspection.

28. Food adulteration- common adulterants in foods and tests to detect common adulterants.

29. Water Balance – Functions of water, water distribution, maintenance of water and regulation of acid-base balance in the body

30-31. Food preparation techniques – Dry heat method, moist heat method, microwave heating and solar heating methods

Merits and demerits of cooking methods.

32. Enzymatic and Non- enzymatic Browning reactions of fruits and vegetables

References:

- Swami Nathan M (1992) Handbook of Food Science and Experimental foods. 2nd Ed. Bangalore.
- Sri Lakshmi L (2004) Food Science. New Age Int.
- Meyers LH. (1969) Food Chemistry, Van Nostr and Reinhold Co.
- Pecham GG, Foundation of food preparation.1972. Mac millan Publishers.
- Potter NH and Hotchkiss JH (1996) Food Science. 5thed.. New Delhi, CBS pbs.
- Sethi M and Rao SE (2001) Food science experiments and application. CBS pbs. New Delhi.
- Food Quality Evaluation (2013) Eram S.Rao

Course No. : PYAE-2.0.1

Course Title: Physical education, first aid, yoga practices and meditation-2(0+2)

Lecture Outlines:

1 Cricket, physical education; training and coaching - meaning & concept; methods of training; aerobic and aerobic exercises

2 Foot ball, balanced diet and nutrition , effects of diet on performance

3 Table tennis-physiological changes due to ageing and role of regular exercise on ageing process;

4 Badminton- personality, its dimensions and types; role of sports in personality development

5 Volley ball- motivation and achievements in sports

6 Basket ball-learning and theories of learning

7 Kabaddi-adolescent problems & their management

8 Kho kho-posture; postural deformities; exercises for good posture.

9 Runs in athletics, first aid related with wounds and injuries

10 Jumps in athletics, first aid related with bones, joints muscle related injuries

11 Throws in athletics, first aid related with nervous system and unconsciousness

12 First aid, need and requirement of first aid. First aid equipment and upkeep. First aid techniques

13 Weight training

14 Circuit training

15 Interval training

16 Fartlek training

17 Yoga:history of yoga, types of yoga, introduction to yoga,

18 Surya namaskara :asanas (definition and importance) padmasan, gaumukhasan, Bhadrasan, vajrajasan, shashankasan, pashchimotasan, ushtrasan, tadasan, padhastasan, ardhchandrasan, bhujangasan, utanpadasan, sarvangasan , parvatasan

19 Meditation mudras: pavan muktasan ,halasan , sarpasan, ardhdhanurasan, sawasan

Surya namskara pranayama (definition and importance

20 Balanced diet and nutrition

21 Diet on performance

22 Postural deformities

23 Exercise for good posture

24 Yoga asanas :omkar, suryabhedan, chandrabhedan, anulomvilom, shitali, shitkari, bhastrika, bhramari, Meditation(definition and importance), yogic kriyas (kapalbhati , tratak, jalneti and Tribandh

25 Teaching of asanas demonstration, practice, correction and practice.

26 Mudras (definition and importance) gyanmudra, dhyanmudra, vayumudra, akashmudra, Pruthvimudra, shunyamudra, suryamudra, varunmudra, pranmudra, apanmudra, Vyanmudra, uddanmudra

27 Role of sport in respiratory system

28 Role of sport in digestive and circulatory system

29 Role of yoga in sports

30 Surya namaskara

31 Meditation mudras :sports injuries and their treatments

32 Calisthenics-history of sports and ancient games, governance of sports in India; important national sporting

References

- O.P. Aneja. Encyclopaedia of Physical education, sports and exercise science (4 volumes).
- Anil Sharma. Encyclopaedia of Health and Physical Education (7 Volumes).
- N V Chaudhery, R Jain. Encyclopedia of Yoga Health and Physical Education (7 Volumes).
- Pintu Modak, O P Sharma, Deepak Jain. Encyclopaedia of Sports and Games with latest rules and regulations (8 volumes).
- Edwin F Bryant. Yoga sutrap of Patanjali.

Course No.: HESE-2.12.1

Course Title: Maintenance of Micro-irrigation Systems and Drone Technology in Horticulture

-2(0+2)

Lecture Outlines:

Practicals

1. Study and selection of different components of sprinklers and drip irrigation system.
2. Determination of water requirement and irrigation scheduling
3. Study on layout of sprinkler irrigation system
4. Study of operation and maintenance of sprinkler irrigation system
5. Troubles and remedies in sprinkler irrigation system
6. Field evaluation on distribution pattern and Uniformity coefficient
7. Cost estimation and economic evaluation of sprinkler irrigation system for field crops
8. Determination of irrigation scheduling for row crops and orchards under drip irrigation system.
9. Study of layout of drip irrigation system
10. Design of drip irrigation for different vegetable crops and fruit crops
11. Demonstration of Fertigation using fertilizer tank and venture

12. General maintenance of drip irrigation system
13. Demonstration of chlorine treatment, acid treatment and pressure variation in maintenance of drip irrigation System
14. Cost estimation and economic evaluation of drip irrigation system for field crops
15. Study of sub surface drip irrigation and micro sprinklers
16. Special application of drip and sprinkler irrigation systems
17. Overview of drone technology, Importance of drones in agriculture.
18. Types of agricultural drones (fixed-wing, rotary-wing, multi-rotor), Regulatory framework and compliance requirements for agricultural drone operations.
19. Understanding the components of a drone (frame, motors, propellers, flight controller, sensors, *etc*.),
20. Functionality of each component and its role in drone operation, basics of drone aerodynamics and flight principles.
21. Applications of different sensors in agriculture (crop monitoring, pest detection, irrigation management, *etc*.), Payload integration and compatibility considerations.
22. Principles of flight planning for agricultural drone missions, Selection of appropriate flight parameters (altitude, speed, overlap, *etc*.).
23. Use of mission planning software and tools, Preflight checks and safety protocols.
24. Techniques for data acquisition during drone flights, Post-flight data processing and analysis.
25. Interpretation of aerial imagery and sensor data, Software tools for data processing and visualization.
26. Routine maintenance procedures for agricultural drones,
27. Diagnosing and troubleshooting common issues (motor failure, GPS signal loss, sensor calibration, *etc*.), Battery management and care.
28. Safety protocols for drone operations in agricultural settings.
29. Understanding airspace regulations and restrictions, Emergency procedures and risk mitigation strategies.
30. Micro-irrigation system installation: installation of filters and fertigation equipment, installation of main and sub mains, laying of laterals, punching of laterals, and fixing of emitters, operation of micro-irrigation systems (drip/sprinkler).
31. Maintenance of micro-irrigation system: filter cleaning, maintenance of fertigation equipment, chemical treatment, sub-main and lateral/bi-wall flushing.
32. Introduction to automated irrigation system in open field and greenhouse- sensors for soil moisture, temperature, light control devices, timing devices, fertigation systems, solenoid devices, remote controlled valves system.

References

- Mane, M.S, Ayare, B.L. and Magar, S.S. 2014. Principles of Drip Irrigation Systems. Jain Brothers, New Delhi.
- Mane, M.S. and Ayare, B.L. 2014. Principles of Sprinkler Irrigation Systems. Jain Brothers, New Delhi.
- Michael. A. M. 2012. Irrigation Theory and Pratice. Vikas Publishing House.,New Delhi
- Jack Keller and Ron.D.Bliesener2012.Sprinkler and Trickle Irrigation. Springer, US.
- K. R. Krishna 2018. Agricultural drones Taylor & Francis, Apple Academic press, USA.
- Arun Kumar 2024. A Peaceful Pursuit Work Book on Drone Application in Agriculture Elite Publishing House, New Delhi

Course No.: FLSE-2.3.1

Course Title: Turf and Turf Management-2(0+2)

Lecture Outlines:

Practicals

1. Site analysis and basic requirements pertaining to turf establishment.

2. Evaluation and quality of soil pertaining to turf grass establishment

3&4. Field preparation and layout for turf making

5. Classification of turf grasses

6. Identification and description of cool season turf grass species and varieties

7. Identification and description of warm season turf grass species and varieties

8. Identification and description of broad leaf turf grass species

9. Turf irrigation management-provision of drainage

10. Turf irrigation management-layout of macro and micro irrigation systems

11. Nutrient management in turf grasses

12. Special practices in turf management-moving

13. Special practices in turf management-raking

14. Special practices in turf management-rolling

15. Special practices in turf management-soil top dressing

16. Nutrient management in turf grasses

17. Rejuvenation of old and withered turf

18 &19. Equipment for turf management

20. Selection and maintenance of grasses for Golf course

21. Selection and maintenance of grasses for Cricket ground

22. Turfing for roof top gardens

23. Applications and use of Turf growth regulators (TGRs)

24. Identification of seasonal turf grass weeds

25. Integrated approaches for turf weed management (Monocot weeds)

26. Integrated approaches for turf weed management (Dicot weeds)

27. Identification and management of Turf grass diseases

28. Identification and management of Turf grass insect-pests

29. Identification and management of abiotic stress disorders in turf grass

30. Identification and management of nutrient deficiencies in turf grass

31. Visit to turf grass play grounds

32. Visit to turf grass nursery

References

- Miller, R.W.(1988). Urban Forestry. Prentice Hall International Ltd. London
- Singh, S.P. (1986). Planting of Trees. B.R. Publishing Corporation, Delhi.
- Urban Forestry and Urban Greening. An International Journal aimed at presenting high-quality research with urban and peri-urban woody and non-woody vegetation and its use, planning, design, Elsevier Publications.
- Bose, T.K. Mukherjee, D. 2004. Gardening in India. Oxford & IBH Publishers.
- Chadha, K.L. and Chaudhary, B. 1986. Ornamental Horticulture in India. Publication and Information division. ICAR, New Delhi.

Course No.: FLSE-2.3.2

Course Title: Computer aided Designing : 2(0+2)

Lecture Outlines

Practicals

1. Designing garden on graph paper.

2. Computer aided designing, applications and AUTOCAD basics

3 - 4. Coordinate systems in AUTOCAD 2D
5. Point picking methods, toolbars and icons in AUTOCAD
6 - 7. Creating AUTOCAD shapes
8 -9. Modifying tools in AUTOCAD
10 -11. Using patterns in AUTOCAD drawing-Hatch, Gradient and editing
12. Text command, Text style and editing
13 - 14. Layers (creation of new layers, layer names, colours to layers, line types, weight, freeze)
15 - 16. Blocks-Creating blocks, inserting blocks, controlling color and line type of blocks, W block command
17 - 18. Creating legends for plant and non plant components
19 - 20.File handling functions
21 - 22. Dimension concepts-Dimension tools, Dimension style and practice
23. Inquiry tools in AUTOCAD and practice
24. Hyper linking and practice
25 - 26. Making sample drawing for outdoor garden by AUTOCAD 2D
27 - 28. Making sample drawing for indoor garden by AUTOCAD 2D
29. 3D drawing methods and elements of ARCHICAD file system.
30 - 31. Basic concepts of photoshop

32.Visit to model gardens by AUTOCAD.

References:

- Manual of Pattern Making Software

Course No.: ASSE-2.9.1

Course Title: Management of Organic wastes-2(0+2)

Lecture Outlines:

Practicals

1. Manures, types and importance in agriculture
2. Waste recycling – objectives, need and scope for waste recycling
3. Farm Yard manure- Preparation, uses and application methods
4. Integrated technologies, feasibility and social acceptance of waste recycling
5. Characteristics of organic waste- Agro-industrial, Animal and Human wastes
6. Pollution caused by human wastes & other wastewaters
7. Management of human & animal wastes
8. Composting -objectives, benefits, and limitations of composting
9. Composting - Biochemical reactions, Biological succession, compost maturity, various factors affecting compost and Environmental requirements
10. Composting systems and design criteria, public health aspects of composting, Utilization of composted products
11. Bangalore and Indore methods of composting
12. NADEP and Coimbatore method of composting
13. ADCO and VAT/Japanese method of composting
14. Vermicompost technology- Production and maintenance of Vermibeds
15. Vermicompost technology- Problems and possible solutions, Uses and applications.
16. Vermiwash- Production, use and applications
17. Enrichment of FYM with Biofertilizers and fertilizers
18. Objectives, benefits, and limitations of biogas technology
19. Biochemical reactions and microbiology of anaerobic digestion, Modes of operation and types of biogas digesters.
20. Biogas production, end users of biogas and digested slurry and Ethanol production
21. Natural Farming- Scope, methods and importance; Beejamrutham preparation, uses and application methods
22. Jeevamrutham, types, preparation and application methods
23. Preparation of various concoctions-Neemastra and Brahmastra/Agniastra
24. Estimation of nutrients in manures by titrimetrty
25. Estimation of nutrients in manures by calorimetry/Turbidometry
26. Estimation of nutrients in manures by flame photometry
27. Visit to farmers field practicing natural/organic farming
28. Visit to Biofertilizer production unit

29. Visit to vermicompost unit
30. Management of organic waste recycling program- Planning for waste recycling programs
31. Case study of waste recycling-I
32. Case study of waste recycling-II

References:

- Manures and Fertilizers byYawalkar. K.S. Agarwal. J.P. and Bokde, S. 1977. Agri-Horticultural Publishing House, Nagpur
- **Organic Waste Recycling** Technology and Management, **3rd Edition,** Chongrak Polprasert IWA pulishers, 2007
- Soil Science an introduction- ISSS 2015

SKILL ENHANCEMENT COURSESIII

SKILL ENHANCEMENT COURSES-III

Course No.: HESE-2.12.1

Course Title: Maintenance of Micro-irrigation Systems and Drone Technology in Horticulture-2(0+2)

Lecture Outlines:

33. Study and selection of different components of sprinklers and drip irrigation system.
34. Determination of water requirement and irrigation scheduling
35. Study on layout of sprinkler irrigation system
36. Study of operation and maintenance of sprinkler irrigation system
37. Troubles and remedies in sprinkler irrigation system
38. Field evaluation on distribution pattern and Uniformity coefficient
39. Cost estimation and economic evaluation of sprinkler irrigation system for field crops
40. Determination of irrigation scheduling for row crops and orchards under drip irrigation system.
41. Study of layout of drip irrigation system
42. Design of drip irrigation for different vegetable crops and fruit crops
43. Demonstration of Fertigation using fertilizer tank and venture
44. General maintenance of drip irrigation system
45. Demonstration of chlorine treatment, acid treatment and pressure variation in maintenance of drip irrigation System
46. Cost estimation and economic evaluation of drip irrigation system for field crops
47. Study of sub surface drip irrigation and micro sprinklers
48. Special application of drip and sprinkler irrigation systems
49. Overview of drone technology, Importance of drones in agriculture.
50. Types of agricultural drones (fixed-wing, rotary-wing, multi-rotor), Regulatory framework and compliance requirements for agricultural drone operations.
51. Understanding the components of a drone (frame, motors, propellers, flight controller, sensors, *etc*.),
52. Functionality of each component and its role in drone operation, basics of drone aerodynamics and flight principles.
53. Applications of different sensors in agriculture (crop monitoring, pest detection, irrigation management, *etc*.), Payload integration and compatibility considerations.
54. Principles of flight planning for agricultural drone missions, Selection of appropriate flight parameters (altitude, speed, overlap, *etc*.).
55. Use of mission planning software and tools, Preflight checks and safety protocols.
56. Techniques for data acquisition during drone flights, Post-flight data processing and analysis.

57. Interpretation of aerial imagery and sensor data, Software tools for data processing and visualization.
58. Routine maintenance procedures for agricultural drones,
59. Diagnosing and troubleshooting common issues (motor failure, GPS signal loss, sensor calibration, *etc.*), Battery management and care.
60. Safety protocols for drone operations in agricultural settings.
61. Understanding airspace regulations and restrictions, Emergency procedures and risk mitigation strategies.
62. Micro-irrigation system installation: installation of filters and fertigation equipment, installation of main and sub mains, laying of laterals, punching of laterals, and fixing of emitters, operation of micro-irrigation systems (drip/sprinkler).
63. Maintenance of micro-irrigation system: filter cleaning, maintenance of fertigation equipment, chemical treatment, sub-main and lateral/bi-wall flushing.
64. Introduction to automated irrigation system in open field and greenhouse- sensors for soil moisture, temperature, light control devices, timing devices, fertigation systems, solenoid devices, remote controlled valves system.

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- Mane, M.S. and Ayare, B.L. 2014. Principles of Sprinkler Irrigation Systems. Jain Brothers, New Delhi.
- Michael. A. M. 2012. Irrigation Theory and Pratice. Vikas Publishing House.,New Delhi
- Jack Keller and Ron.D.Bliesener2012.Sprinkler and Trickle Irrigation. Springer, US.
- K. R. Krishna 2018. Agricultural drones Taylor & Francis, Apple Academic press, USA.
- Arun Kumar 2024. A Peaceful Pursuit Work Book on Drone Application in Agriculture Elite Publishing House, New Delhi

Course No.: FLSE-2.3.1

Course Title: Turf and Turf Management-2(0+2)

Lecture Outlines:

1. Site analysis and basic requirements pertaining to turf establishment.

2. Evaluation and quality of soil pertaining to turf grass establishment

3&4. Field preparation and layout for turf making

5. Classification of turf grasses

6. Identification and description of cool season turf grass species and varieties

7. Identification and description of warm season turf grass species and varieties

8. Identification and description of broad leaf turf grass species

9. Turf irrigation management-provision of drainage

10. Turf irrigation management-layout of macro and micro irrigation systems

11. Nutrient management in turf grasses

12. Special practices in turf management-moving

13. Special practices in turf management-raking

14. Special practices in turf management-rolling

15. Special practices in turf management-soil top dressing

16. Nutrient management in turf grasses

17. Rejuvenation of old and withered turf

18 &19. Equipment for turf management

20. Selection and maintenance of grasses for Golf course

21. Selection and maintenance of grasses for Cricket ground

22. Turfing for roof top gardens

23. Applications and use of Turf growth regulators (TGRs)

24. Identification of seasonal turf grass weeds

25. Integrated approaches for turf weed management (Monocot weeds)

26. Integrated approaches for turf weed management (Dicot weeds)

27. Identification and management of Turf grass diseases

28. Identification and management of Turf grass insect-pests

29. Identification and management of abiotic stress disorders in turf grass

30. Identification and management of nutrient deficiencies in turf grass

31. Visit to turf grass play grounds

32. Visit to turf grass nursery

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- Singh, S.P. (1986). Planting of Trees. B.R. Publishing Corporation, Delhi.
- Urban Forestry and Urban Greening. An International Journal aimed at presenting high-quality research with urban and peri-urban woody and non-woody vegetation and its use, planning, design, Elsevier Publications.
- Bose, T.K. Mukherjee, D. 2004. Gardening in India. Oxford & IBH Publishers.
- Chadha, K.L. and Chaudhary, B. 1986. Ornamental Horticulture in India. Publication and Information division. ICAR, New Delhi.

Course No.: FLSE-2.3.2
Course Title: Computer aided Designing -2(0+2)
Lecture Outlines

1. Designing garden on graph paper.
2. Computer aided designing, applications and AUTOCAD basics
3 - 4. Coordinate systems in AUTOCAD 2D
5. Point picking methods, toolbars and icons in AUTOCAD
6 -7. Creating AUTOCAD shapes
8 - 9. Modifying tools in AUTOCAD
10 & 11. Using patterns in AUTOCAD drawing-Hatch, Gradient and editing
12. Text command, Text style and editing
13 - 14. Layers (creation of new layers, layer names, colours to layers, line types, weight, freeze)
15 - 16. Blocks-Creating blocks, inserting blocks, controlling color and line type of blocks, W block command
17 - 18. Creating legends for plant and non plant components
19 -20.File handling functions
21 - 22. Dimension concepts-Dimension tools, Dimension style and practice
23. Inquiry tools in AUTOCAD and practice
24. Hyper linking and practice
25 -26. Making sample drawing for outdoor garden by AUTOCAD 2D
27 - 28. Making sample drawing for indoor garden by AUTOCAD 2D
29. 3D drawing methods and elements of ARCHICAD file system.
30 - 31. Basic concepts of photoshop
32. Visit to model gardens by AUTOCAD.

References:

- Manual of Pattern Making Software

Course No.: ASSE-2.9.1

Course Title: Management of Organic wastes-2(0+2)

Lecture Outlines:

Practicals

1. 1Manures, types and importance in agriculture
2. Waste recycling – objectives, need and scope for waste recycling
3. Farm Yard manure- Preparation, uses and application methods
4. Integrated technologies, feasibility and social acceptance of waste recycling
5. Characteristics of organic waste- Agro-industrial, Animal and Human wastes
6. Pollution caused by human wastes & other wastewaters
7. Management of human & animal wastes
8. Composting -objectives, benefits, and limitations of composting
9. Composting - Biochemical reactions, Biological succession, compost maturity, various factors affecting compost and Environmental requirements
10. Composting systems and design criteria, public health aspects of composting, Utilization of composted products
11. Bangalore and Indore methods of composting
12. NADEP and Coimbatore method of composting
13. ADCO and VAT/Japanese method of composting
14. Vermicompost technology- Production and maintenance of Vermibeds
15. Vermicompost technology- Problems and possible solutions, Uses and applications.
16. Vermiwash- Production, use and applications
17. Enrichment of FYM with Biofertilizers and fertilizers
18. Objectives, benefits, and limitations of biogas technology
19. Biochemical reactions and microbiology of anaerobic digestion, Modes of operation and types of biogas digesters.
20. Biogas production, end users of biogas and digested slurry and Ethanol production
21. Natural Farming- Scope, methods and importance; Beejamrutham preparation, uses and application methods
22. Jeevamrutham, types, preparation and application methods
23. Preparation of various concoctions-Neemastra and Brahmastra/Agniastra
24. Estimation of nutrients in manures by titrimetrty
25. Estimation of nutrients in manures by calorimetry/Turbidometry
26. Estimation of nutrients in manures by flame photometry
27. Visit to farmers field practicing natural/organic farming
28. Visit to Biofertilizer production unit
29. Visit to vermicompost unit
30. Management of organic waste recycling program- Planning for waste recycling programs
31. Case study of waste recycling-I
32. Case study of waste recycling-II

References:

- Manures and Fertilizers by Yawalkar. K.S. Agarwal. J.P. and Bokde, S. 1977. Agri-Horticultural Publishing House, Nagpur
- Organic Waste Recycling Technology and Management, 3rd Edition, Chongrak Polprasert IWA pulishers, 2007
- Soil Science an introduction- ISSS 2015

LECTURE OUTLINES FOR IV SEMESTER COURSES

Course No.: FRMJ-2.1.1

Course Title: Commercial Fruit production -4 (3+1)

Lecture Outlines:

Theory:

1. Classification of fruits based on climate adaptability, bearing habit, fruit morphology, rate of respiration, photoperiodic response, salt tolerance, acid tolerance, longevity, consumer preference or

weight of fruits, growth curve and botanical relationship with genomes. Scope and importance of fruit crops. National research stations working on different fruit crops.

2. Mango: Introduction & History, Nutritive Value, Uses, Origin & Distribution Area and Production, Export Potential, Importing Countries, Important Species of Mango Production Technology: Climate requirements- Temperature, rainfall and other requirements for optimum vegetative growth, flowering, and fruit development under North Indian and South Indian conditions Soil requirements.
3. Mango Varieties: Indian and Exotic varieties- Varieties suitable for export, commercial varieties- Table varieties, Juicy varieties, Table and Juicy Varieties, Pickle Varieties, Varieties suitable for Preservation, Early, Late and off-Season Varieties, Mono & Poly embryonic varieties, Varieties suitable for different regions of India &A.P. (Rayalsesema and Coastal) and Varieties of North, South, East and West India; Hybrids of Mango released for cultivation all over India.
4. Propagation: Commercial propagation by Epicotyl grafting, Veneer grafting planting Density; High Density Planting system. Nutritional and Irrigation requirement; Role of Major & Minor nutrients, Inter cultivation; Inter cropping, Weed management.
5. Special Horticultural Practices: Manipulation of flowering through canopy management & application of plant growth regulators, Flowering: Environmental factors influencing flowering, types of flowers, agents of pollination, fruit set, fruit drop and its control.
6. Alternate Bearing/Biennial Bearing: Causes and control, Physiological Disorders & their control: Malformation (Vegetative & Floral), Black Tip, Spongy Tissue, and leaf Scorch. Harvesting & Yield: Harvest Indices, Methods of Harvesting, Grading, Packing, Transport. Storage and Ripening.
7. Banana : Economic importance-Nutritive value, Uses, Origin of various groups & Distribution, Area & Production; Genomic classification and Nomenclature; Taxonomic Classification: Musa acuminate Musa bulbisiana Major genomic groups and Cultivars in the world and Hybrids, Production Technology: Climate, Soil requirements. Propagation by Suckers, Treatment of suckers before planting; Micro Propagation: Planting density Irrigation
8. Nutritional requirements: Fertilizer doses, Management of Banana crop: Desuckering, Ratoon sucker selection, Weed control, Mulching, Earthing up. Leaf removal, Provision of Wind breaks; Bunch management: Propping of bunches, Wrapping, Trimming, Removal of Male bud, Bunch covering.
9. Harvesting & Yield: Harvest Indices, Methods of Harvesting, Grading, Packing, Transport, Storage, Ripening and physiological disorders.
10. Citrus: Introduction and History, Economic importance, Nutritive value of Sweet and Acid groups, Uses, Origin & Distribution, Area & Production and Export Potential, classification of Citrus
11. Production Technology of mandarins and sweet oranges: Climate & Soil requirements, Varieties, Fertilizer doses recommended, Irrigation requirement, Weed control, Harvesting & Yield: Harvest Indices, Methods of Harvesting, Grading, Packing, Transport, Storage, Ripening and physiological disorders.
12. Production Technology of Acid limes and lemon: Climate & Soil requirements, Varieties, Fertilizer doses recommended, Irrigation requirement ,Weed control, Harvesting & Yield: Harvest Indices, Methods of Harvesting, Grading, Packing, Transport, Storage, Ripening and physiological disorders.
13. Production Technology of pummelo and grape fruit: Climate & Soil requirements, Varieties, Fertilizer doses recommended, Irrigation requirement, Weed control, Harvesting & Yield: Harvest Indices, Methods of Harvesting, Grading, Packing, Transport, Storage, Ripening.
14. Propagation: Seedling stocks, Root stocks tolerant to disease, stock & Scion relationship, methods of propagation - Bud Wood Certification-Virus free bud wood, Nucellar clones, Virus indicator species in citrus.
15. Crop regulation, Bahar Treatment: (Ambebahar, Mrig Bahar; and Hastha bahar), Flowering: Factors effecting fruits set, Fruit drop and its control, Physiological Disorders like Granulation, and Rind pitting; Citrus Decline; Symptoms, Factors responsible and Control measures.
16. Grapes: Economic importance, Nutritive value, Uses, Origin & Distribution. Area & Production; Genera; Vitis & Muscadinia, Species grown in different regions of the World: Varieties; Indian and Exotic Varieties –Seeded & Seedless Varieties, Coloured varieties, Varieties suitable for table, wine, juice, Canning and raisin purpose, Production Technology: Climate requirements, Soil requirements, Propagation, Method of propagation of root stocks, Planting Density and Planting
17. Training: Purpose, systems of training (Bower, telephone system, Trellis system-T and Y-vertical cordon system –Single & double, kniffin system, Gable system), Nutritional roles of Major & Minor nutrients, Fertilizer Scheduling, Irrigation; Symptoms of water deficit; Pruning; Objectives, Definitions of Cane, Spur, Shoot, Fruiting Spur, Foundation Spur/ Renewal Spur, Long Spur, Medium Spur, Arms, Trunk, Suckers etc. Pruning for vegetative growth (summer) and for fruiting (winter), Level of pruning, bud forecasting.
18. Improvement of yield through practices like girdling, pinching thinning of flowering and berry drop. Fruit set, Stenospermocarpy, Stages of berry growth; Uses of plant growth regulators to induce 1) Seedlessness 2) Improve quality and for 3) crop regulation.

19. Maturity Standards, Harvesting & Yield, Grading, Packing, Storage and Ripening: Physiological Disorders; Blossom end rot, Inter-venial chlorosis, Poor Bud Burst, flower and Berry drop, Barrenness of vines, Pink berry, Cracking of Rachies
20. Sapota: Economic Importance, Nutritive value, Origin & Distribution, Area & Production; Species & Types; Types based on growing habit (Erect, Drooping and spreading), Varieties and hybrids; Production Technology; Climate & Soil requirements; Propagation, Root Stocks, Planting Density, methods of irrigation, nutrient management, Intercultural operations, weed management and inter-cropping, Maturity Indices, Harvest & Yield; Handling, Grading, Packing, Transport, Marketing, Ripening and Storage.
21. Guava: Economic Importance, Nutritive value, Origin & Distribution , Area & Production,; Species & Varieties (Indian & Exotic), Hybrids; Production Technology; Soil & Climate requirements, Propagation by vegetative methods (Air layering, Ground layering and Stooling); Planting, Planting density, Irrigation, Nutrient management.
22. Training and pruning. Bahar treatment (Ambe bahar, Mrig bahar and Hasta Bahar), Flowering, plant growth Regulators for Fruit thinning and Parthenocarpy, Maturity Indices, Harvesting & Yield, packing, Transportation, and storage.
23. Jackfruit, Breadfruit and Durian: Economic Importance, Nutritive value, Origin & Distribution, Area & Production; Species & Types; Types based on fruit characters, Varieties and hybrids; Production Technology; Climate & Soil requirements; Propagation, Planting, method of irrigation, nutrient management, Intercultural operations, weed management and inter-cropping, Maturity Indices, Harvest & Yield; Handling, Grading, Packing, Transport, Marketing, Ripening and Storage.
24. Papaya: Economic Importance, Nutritive value, Origin & Distribution, Area & Production; Varieties: (Pusa varieties, Coimbatore varieties, Taiwan varieties etc.); Sex expression and Sex identification. Production Technology: Soil & Climatic requirements, Propagation, Planting, Irrigation & Nutrient management.
25. Maturity indices, Harvesting, Yield and storage, Latex extraction; Papain: uses, factors effecting Papain production, suitable varieties for Papain, Extraction & Yield of Papain, Marketing & Prospects.
26. Pine Apple: Economic Importance, Nutritive value, Origin & Distribution, Area & Production, Varieties; Groups: Spanish, Abacaxi, Queen, Cayene, Maipore Production Technology; Soil & Climate requirements; Propagation; by shoot suckers, Ground suckers, slips, crowns, stumps, micro propagations.
27. High Density Planting, Water and Nutrient management, Intercultural, flowering and fruiting. Use of chemical and plant growth regulators for improving the flowering and fruiting, Maturity indices, Harvesting for local market and Distant markets, Yield, Post harvest handling; and storage, physiological disorders.
28. Litchi: Economic Importance, Nutritive value, Origin & Distribution, Area & Production, Species & varieties: Exotic/Indian varieties –Early, Mid-season and Late season varieties; Production technology: Soil and climatic requirements; propagation, Nutrient Management, Irrigation, Interculture, flowering and fruiting, fruit drop and its control; Maturity indices, Harvesting, yield, Post Harvest handling and Storage; Regulation of colour break in litchi, Physiological disorders: Fruit cracking.
29. Rambutan: Economic Importance, Nutritive value, Origin & Distribution, Area & Production, Exotic varieties, Propagation, Planting density, Nutrient Management, Flowering, Harvesting and Yield
30. Avocado: Economic Importance, Nutritive value, Origin & Distribution, Area & Production, Species and Varieties: Different Races- Mexican, Guatemalan and West Indian races, Cultivars of three races, production technology: Soil and Climatic requirements; propagation density, planting, pruning; Irrigation, Nutrition, Flowering and Fruiting: Diurnally synchronous Dichogamy; Maturity indices, Harvesting, Yield.
31. Passion fruit: Economic Importance, Nutritive value, Origin & Distribution, Area & Production; Species & Types; (Purple, Golden yellow, Hybrid (Kaveri), Noel's special), Varieties and hybrids; Production Technology; Climate & Soil requirements; Propagation, Planting methods and training, method of irrigation, nutrient management, Intercultural operations, weed management and Flowering Fruiting, fruit set, Harvesting indices and Harvesting, Yield, Handling, Grading, Packing, Transport.
32. Carambola, Bread fruit, Durian, Mangosteen and Loquat: Economic Importance, Nutritive value, Origin & Distribution, Area Production; Important Species & Cultivars, Production technology, Harvesting.
33. Apple: Introduction, origin, and distribution, composition and uses, area, production, varieties, climate and soil requirements, root stocks (Dwarf, Semi-dwarf, Vigorous root stocks, M-Series and MM- Series root stocks), Propagation, planting methods, Training & Pruning methods of Apple.

34. Manures and fertilizers and After care, Biennial bearing- Flowering, Induction of early flowering, use of growth regulators in flowering, Pre harvest drop, Blossom and fruit thinning.
35. Factors effecting colour development, Harvesting, Different maturity indices, Post harvest handling, Grades followed in India, storage and physiological disorders of apple.
36. Pear: Introduction, centres of origin, and distribution, different species of pear, composition and uses, area, production, varieties, climate and soil requirements, root stocks, propagation, Training & pruning of pear
37. Manures and fertilizers, Intercropping, flowering and fruiting and use of growth regulators, harvesting, maturity indices, post -harvest handling and storage of Pear
38. Peach: Introduction, origin, and distribution, varieties, Composition and uses, different species of peach, area, production, climate and soil requirements, root stocks, propagation, Training & pruning of young trees, bearing trees and rejuvenation of old peach trees.
39. Manures and fertilizers, Intercropping, flowering and different stages of stone fruit growth and stages of maturity, maturity indices, harvesting, post-harvest handling and storage and physiological disorders of Peach
40. Plum: Introduction, origin, and distribution, varieties, composition and uses, difference between European plums and Japanese plums, Types of European plums, area, production, climate and soil requirements, root stocks, propagation, Manures and fertilizers, Training & pruning, flowering, pollination and fruit set, maturity indices, harvesting, post-harvest handling and storage of Plum.
41. Apricot: Introduction, origin, and distribution, varieties, composition and uses, different species of Apricot, area, production, climate and soil requirements, root stocks, propagation, Training & pruning of young trees, bearing trees and rejuvenation of old Apricot trees.
42. Manures and fertilizers, flowering, pollination and fruit set, maturity indices, harvesting, post-harvest handling and storage of Apricot.
43. Strawberry: Introduction, origin, and distribution, varieties, composition and uses, Ploidy series, climate and soil requirements, Vegetative propagation, rising of runners
44. Different systems of planting, Matted rows, spaced beds and Hill system Mulching, Flowering (June/Ever/day neutral bearers), pollination, defoliation and de blossoming operation, Fruit set, Harvesting and Post harvest management and Physiological disorder (Albinism) in Strawberry
45. Almond: Introduction, origin, and distribution, varieties, composition and uses, area, production, climate and soil requirements, root stocks, propagation, Manures and fertilizers, Training & pruning, flowering, pollination and fruit set, maturity indices, harvesting(mechanical), post-harvest handling and storage, Kernel use, shelling yield, grades of kernels for the international trade.
46. Kiwi: Introduction, origin, and distribution, composition and brief production technology Replanting problems, rejuvenation and special production problems like pre-mature, leaf fall, unfruitfulness, alternate bearing, control of pre-harvest fruit drop, important insect pests and diseases and their control measures.
47. Cherry and Walnut : Introduction, origin, and distribution, composition and brief production technology Replanting problems, rejuvenation and special production problems like pre-mature, leaf fall, unfruitfulness, alternate bearing, control of pre-harvest fruit drop, important insect pests and diseases and their control measures.
48. Minor temperate nut crops viz., Queens land nut(Macadamia nut), Pecan nut, Hazel nut and Chest nut: Introduction, origin, and distribution, composition and brief production technology Replanting problems, rejuvenation and special production problems like pre-mature, leaf fall, unfruitfulness, alternate bearing, control of pre-harvest fruit drop, important insect pests and diseases and their control and re-planting problems, rejuvenation and special production problems like pre-mature, leaf fall, unfruitfulness, alternate bearing, control of pre-harvest fruit drop, important insect pests and diseases and their control measures.

Practicals:

1. Description and identification of varieties of Mango based on leaf, flower and Fruit morphology
2. Description and identification of varieties of Banana based on fruit morphology
3. Description and identification of varieties of citrus crops
4. Description and identification of varieties of Grape
5. Description and identification of varieties of Papaya, Sapota, Jackfruit
6. Description and identification of varieties of Guava and pineapple
7. Description and identification of varieties of Avocado, Litchi, passion fruit, Carambola, Durian and Mangosteen.
8. Description and identification of varieties of Apple, Pear, Peach, and Plum

9. Description and identification of varieties of Apricot, Almond and Cherry
10. Description and identification of varieties of Strawberry, Kiwi, Walnut
11. Description and identification of varieties of Hazel nut, Chestnut, Pecan nut and Queens land nut
12. Training and Pruning of Grapes, Mango, Guava and Citrus.
13. Training and Pruning of Apple, Pear, Plum, Peach and Kiwi
14. Methods of application, calculation of the required Manure, Fertilizers and bio-fertilizers – Methods of weed control.
15. Maturity standards, harvesting, handling, grading and packaging of tropical fruits, subtropical fruits, Pome fruits, stone fruits and nut crops
16. Visit to commercial orchards -diagnosis of maladies (Nutrient deficiencies, Pest & Diseases, Physiological disorders, *etc*.)

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- M.S.Ladaniya, 2013. Citrus Fruits. Elsevier, India post ltd.
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- W S Dhillon, 2013. Fruit Production in India. Narendra Publishing House, New Delhi
- R.E.Litz, 2009. The Mango 2nd Edn. Cabi Publishing, Willingford, U.K.
- K.L.Chadda, 2009. Advanced in Horticulture. Malhotra Publishing House, New Delhi.
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- F.S. Davies and L.G.Albrigo, 2001. Citrus, Cab International
- Chattopadhyay T.K.2009.A text book on Pomology-IV Devoted to Temperate fruits. Kalyani Publishers.B-1/292,Rajinder Nagar,Ludhiana-141008
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- Chadha, T.R, 2001. Text Book of Temperate Fruits. Indian Council of Agricultural Research, New Delhi.
- David Jackson & N E Laone, 1999 Subtropical and Temperate Fruit Production. CABI, Publications.

Course No.: HEMJ-2.12.1

Course Title: Farm Power and Machinery for Horticulture - 3(2+1)

Lecture Outlines:

Theory:

1. Farm power – sources of different farm power – advantages and disadvantages, Conventional and non-conventional energy sources.
2. Internal combustion engine – different components and their functions – working principle of four stroke and two stroke cycle engine – comparison between diesel and petrol engine – difference between four stroke engine and two stroke engine.

3. Terminology related to engine power – Indicated Horsepower (IHP), Brake Horsepower (BHP), Frictional Horsepower (FHP), Drawbar Horsepower (DBHP), Compression Ratio (CR), Stroke Bore Ratio, Piston displacement and Mechanical efficiency – numerical problems.
4. Fuel supply System of Internal Combustion (IC) engine-Fuel properties
5. Cooling system of – types –components and their functions – working Principle of air cooling system, merits and demerits of air cooling system, working principle of forced circulation cooling system.
6. Ignition system of IC engine – types – components and their functions – working principle of battery ignition system
7. Lubrication system of IC engine – types – purpose – components and their functions – working principle of forced feed system.
8. Power transmission-Functions and Components of Power Transmission system, types of clutch, transmission gears, differential and final drive.
9. Tractors – classification – types – points to be considered in selection of tractors – estimating the cost of operation of tractor power and problems
10. Introduction to tillage – Objectives, advantages, Classification Tillage – primary and secondary tillage.
11. Mould Board (MB) plough – functions – constructional features – operational adjustments and maintenance.
12. Disc plough – functions – constructional details – operational adjustments and Maintenance.
13. Ploughing of land, methods of ploughing - Numerical problems on MB plough and disc plough.
14. Harrows – types – functions – operation of disc harrows – cultivators –rotovators – intercultural implements– hoes and weeders
15. Sowing equipment – sowing methods, seed cum fertilizer drills – types – functions – functional components.
16. Types of seed metering mechanism of seed drill, Calibration of seed drill
17. Numerical problems on seed drill calibration.
18. Harvesting equipment –different harvesting equipments used for horticultural crops.
19. Plant protection equipment – types of sprayers and dusters – constructional features and care and maintenance of sprayers and dusters
20. Tractor mounted equipment for land development and soil conservation – functions of bund former, ridger and leveling blade
21. Adjustments affecting performance in tillage equipment, calculation of bite length of rotavator.
22. Construction and working details of Post-hole digger
23. Introduction about planting and transplanting equipment: potato planters, small seed planter
24. Nursery, sowing machinery, vegetable transplanters, plastic mulch and drip laying machinery
25. Dry land and wet land weeders, use of weeders, manual and power operated types -working principles and functional components
26. Plant protection equipment- Sprayers: Types, working principle, manual and tractor operated gun-type and boom type.
27. Special purpose sprayers: aero-blast sprayers, electrostatic sprayers
28. Calibration of sprayer, pumps for sprayer, types of nozzles for different types of spray pattern and nozzle spacing
29. Introduction about inter cultural machinery, Dry land and wet land weeders, use of weeders, manual and power operated types -working principles and functional components
30. Safety features and safe use, shrub cutters, pick positioners
31. Grafting, pruning and training tools and equipment, Sweep and rotary weeders, tractor operated pruners.
32. Crop harvesting, equipment: potato diggers Fruit-pluckers, seed extraction machine – working principle

Practical:

1. Study of different components of IC engine
2. Study of working of four stroke petrol and diesel engine
3. Study of working of two stroke petrol and diesel engine
4. Study of different parts of MB plough, measurement of plough size, horizontal and vertical suction, determination of line of pull, etc.
5. Study of different parts of disc plough and harrows
6. Study of seed-cum-fertilizer drills – furrow openers, seed metering mechanisms and calibration of seed drills
7. Study of different inter cultivation equipment used in Horticultural crops

8. Study of operation and maintenance of tractor and cost calculation
9. Learning of tractor driving – I
10. Learning of tractor driving – II
11. Hitching of tractor drawn implements
12. Study of operation and maintenance of power tiller
13. Study of operation, adjustments and repairs of dusters
14. Study of operation, adjustments and repairs of sprayers
15. Learning of Power tiller driving
16. Visit to nearby Farm Implements manufacturing work shop

References:

- Jagadishwar Sahay. 1992. Elements of Agricultural Engineering. Agro Book Agency, Patna.
- Jain, S.C. 2003. Farm Machinery – An Approach. Standard Publishers and Distributors, New Delhi.
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Course No.: ESVA-2.11.1

Course Title: Agriculture Informatics and Artificial Intelligence-3 (2+1)

Lecture outlines

Theory:

1. Introduction to Computers
2. Anatomy of Computers
3. Generation and classification of computers
4. Memory Concepts, Units of Memory
5. Hardware and Software
6. Operating System: Definition and types
7. Applications of MS-Word for creating, Editing a document
8. Applications of MS-Word for Formatting a document
9. Applications of MS-Power Point for Data presentation, Tabulation and graph creation
10. MS-Excel for Statistical analysis, Mathematical expressions
11. MS-Access for Database, concepts and types, creating database, Uses of DBMS in Agriculture
12. Introduction to computer languages: C, C++
13. Introduction to computer languages: Visual Basic and Java
14. Internet and World Wide Web (WWW): Concepts and components
15. e-Agriculture, Concepts, design and development
16. Application of innovative ways to use information and communication technologies (ICT) in Horticulture
17. Number system in computers
18. Flow chart and algorithm
19. Computer Models in Horticulture: Statistical, weather analysis and crop simulation models
20. Computer Models in Horticulture: concepts, structure, inputs-outputs files, limitation, advantages
21. Computer Models in Horticulture: application of models for understanding plant processes, sensitivity, verification, calibration and validation

22. IT applications for computation of water and nutrient requirement of crops
23. Computer-controlled devices (automated systems) for Agri-input management
24. Smartphone mobile apps in agriculture for farm advice: Market price, postharvest management etc.
25. Geospatial technology: Concepts, techniques, components and uses for generating valuable agri-information
26. Decision support systems: Concepts, components and applications in Horticulture, Agriculture Expert System, Soil Information Systems etc. for supporting farm decisions.
27. Preparation of contingent crop-planning and crop calendars using IT tools
28. Digital India and schemes to promote digitalization of agriculture in India.
29. Introduction to artificial intelligence, background and applications
30. Use of AI in Horticulture for autonomous crop management, and health, monitoring livestock health, intelligent pesticide application
31. Yield mapping and predictive analysis, automatic weeding and harvesting, sorting of produce, and other food processing applications
32. Concepts of smart agriculture, use of AI in food and nutrition science etc.

Practical

1. Study of computer components, accessories
2. Practice of important DOS Commands
3. Introduction of different operating systems such as Windows, UNIX/ Linux, creating files & folders, File Management.
4. Use of MS-Word for creating, editing and presenting a scientific documents
5. Use of MS Power-point for creating, editing for presentation of slides
6. MS - EXCEL - Creating a spreadsheet, Use of statistical tools, Writing mathematical expressions
7. MS - EXCEL - Creating graphs, Analysis of scientific data, handling macros.
8. MS - ACCESS: Creating Database, preparing queries and reports
9. Flow chart and algorithm
10. Demonstration of Agri-information system.
11. Introduction C Program: Sum of natural numbers and area of rectangle
12. Hands on practice on Crop Simulation Models (CSM): DSSAT/Crop-Info/Crop Syst/ Wofost
13. Computation of water requirement of crop using CROPWAT 8.0 and CLIMWAT 2.0
14. Introduction of Geospatial Technology for generating valuable information for Agriculture
15. Hands on practice on preparation of Decision Support System
16. Preparation of contingent crop planning

References

- Rajaraman, V. and Adabala, N., Fundamentals of Computer by PHI Learning Pvt. Ltd., New Delhi
- ITL Educations Solutions Ltd. Introduction to Information Technology. Pearson Education.
- Date, C. J. 2000, Introduction to Database Management System. Addison – Wesley.
- Sethi, D. P. and Pradhan, M. 2017. Concepts and Techniques of Programming in C, I. K. International Publishing House Pvt. Ltd.
- Mahapatra, Subrat K et al. Introductory Agri. Informatics. Jain Brothers Publication.
- Russell, Stuart, 2013. Artificial Intelligence: A Modern Approach. Pearson Edition
- Nilson N.J. 2001. Principles of Artificial Intelligence. Narosa.

Course No.: FLMJ-2.3.1

Course Title: Urban and Peri urban Horticulture – 2 (1+1)

Lecture Outlines:
Theory:

1. Introduction to urban and peri-urban horticulture: Definition, importance, characteristics and scope.
2. Types of urban and peri-urban gardens and their characteristics: Terrace gardening and rooftop gardens (Essentials of roof top gardening and plants suitable for roof gardening).
3. Types of urban and peri-urban gardens and their characteristics: vegetable gardening and container gardening.
4. Types of urban and peri-urban gardens and their characteristics: community gardens, Miyawaki forests and vertical gardens.
5. Types of urban and peri-urban gardens and their characteristics: hydroponics and aeroponics.
6. Selection of site, planting material, media (soil and soilless) preparation and nutrient management for cultivation of vegetables, herbs, fruits, flowers and ornamental plants. Role of drought-tolerant and climate-resilient plant species in urban horticulture.
7. Protected cultivation in urban and peri-urban areas- Agro Shade nets, Poly tunnels, lath houses, Use of IoT in urban gardening (smart irrigation systems, temperature, and moisture monitoring).
8. Establishment and maintenance of lawns-Selection of lawn grasses, different methods of establishment and maintenance of lawn.
9. Interior landscaping in urban and peri-urban households- Need and importance, Indoor ornamentals, Bonsai and window gardens.
10. Exterior landscaping in urban and peri-urban households- Need and importance, Container planting, Living walls, Hanging baskets, Standing baskets, Herb garden, Meditation gardens, Ornamental water features and private fencing.
11. Water and waste management: waste recycling and its use in landscaping- types of wastes and approaches of waste management.
12. Water and waste management: waste water recycling-Existing scenarios and gaps, importance of waste water recycling, process of waste water treatment and Benefits of Reusing treated wastewater in landscaping.
13. Disease management in Fruits and vegetable crops in Urban and Peri Urban Situations - Integrated disease management of mango, citrus, pomegranate, guava tomato, chilli/capsicum, okra, cucurbits, dolichos bean and leafy vegetables and their eco-friendly management
14. Disease management in Urban and Peri Urban Ornamentals - Integrated disease management rose, chrysanthemum, marigold, gerbera, crossandra, tuberose and different ornamentals and their eco-friendly management
15. Pest Management in Fruits and vegetable crops in Urban and Peri Urban Situations- Integrated pest management in important crops like mango, citrus, pomegranate, guava tomato, chilli/capsicum, okra, cucurbits, dolichos bean and leafy vegetables and their eco-friendly management
16. Pest management in Urban and Peri Urban Ornamentals- Integrated pest management of rose, chrysanthemum, marigold, gerbera, crossandra, tuberose and different ornamentals

Practical:

1. Site selection and layout of various urban and peri-urban gardens.
2. Identification of plants suitable for Roof top and Terrace Gardening.
3. Identification and propagation of plants suitable for Interior landscaping.
4. Identification and propagation of plants suitable for Exterior landscaping.
5. Identification and propagation of plants suitable for Vertical Gardening.
6. Types of growing media, preparation of growing media and potting mixtures.

7. Types of containers and nursery raising for roof top gardens.
8. Establishment and Maintenance of ornamental roof top gardens.
9. Establishment and Maintenance of vegetable roof top gardens
10. Establishment and Maintenance of Vertical gardens.
11. Waste management through vermicomposting.
12. Establishment and Maintenance of lawn.
13. Irrigation management in urban and peri-urban horticulture.
14. Nutrient Management in urban and peri-urban horticulture.
15. Visit to fruit nutrition garden and vegetable kitchen garden.
16. Visit to public gardens and nurseries.

References

- Sumangla HP, Malhotra S K and Chowdappa P 2013.Urban and peri-urban horticulture- A perspective.
- Alka Singh, Patel NL, Ahlawat TR 2016. Handbook of Urban and Periurban Horticulture; Publisher: Ambica; 1st.Edition.

Course No.: PTMJ-2.7.2

Course Title: Disease Management of Horticultural Crops -3(2+1)

Lecture Outlines:

Theory:

S.No.	Crop name	Diseases
1-3	Mango	1. Powdery mildew, 2. Anthracnose, 3. Stem end rot, 4.Malformation, 5. Sooty mould, 6. Gummosis, 7. Red rust, 8. Bacterial leaf spot
	Citrus	1.Phytophthora Gummosis, 2. Diplodia gummosis, 3. Dry root rot, 4. Scab, 5. Canker, 6. Greening, 7. Tristeza
	Grapevine	1. Anthracnose, 2. Downy mildew, 3. Powdery mildew, 4. Dead arm
4-7	Banana	1. Panama wilt, 2. Sigatoka leaf spot, 3. Anthracnose, 4. Cigar end rot, 5. Moko disease, 6.Bacterial soft rot/head rot/tip rot, 7. Bunchy top, 8. Mosaic, 9. Banana Streak, 10. Bract mosaic
	Guava	1. Canker 2.Wilt
	Sapota	1.Flat limb, 2. Fruit rot
	Papaya	1.Damping off/ foot rot, 2. Anthracnose, 3. Powdery mildew, 4.Ring spot, 5. Mosaic, 6. Leaf curl
	Pomegranate	1.Cercospora leaf spot, 2.Anthracnose, 3. Bacterial leaf spot
8.	Ber	1. Powdery mildew, 2. Black leaf spot
	Fig	1. Rust, 2. Mosaic
	Phalsa	Rust
	Anola	Rust
9	Apple	1. Scab, 2.Powdery mildew, 3.Fire blight, 4. Crown gall
	Peach	1. Leaf Curl, 2. Rust
10.	Jack fruit	1.Die back, 2. Rhizopus Fruit rot
	Pine apple	1. Heart rot & root rot, 2. Wilt
11 - 13	Coconut	1. Bud rot, 2.Ganoderma root rot, 3.Stem bleeding, 4.Grey blight 5.Tatipaka
	Oil palm	1.Bunch rot, 2.Bud rot
	Areca nut	1. Fruit rot/Mahali/ Koleroga
	Coffee	Rust
	Tea	1. Blister blight
14-15	Cocoa	1.Charcoal pod rot 2.Black pod rot 3.Swollen shoot 4. Cherelle wilt
16	Betelvine	1.Phytophthora root rot, 2. Sclerotium foot rot
	Black Pepper	1. Phytophthora foot rot, 2. Anthracnose/pollu
	Mint	1. Stolon rot

	Opium	1. Powdery mildew, 2. Downy mildew
17-19	Potato	1. Late blight, 2. Black scurf, 3.Wart, 4. Leaf roll, 5.Mosaic, 6.Spindle tuber
	Tomato	1.Damping off, 2.Collar rot, 3.Wilts, 4.Early blight, 5.Buck eye rot, 6.Mosaic
	Brinjal	1. Phomopsis blight and fruit rot, 2.Little leaf
	Chilli	1. Powdery mildew, 2.Cercospora leaf spot, 3.Dieback & Fruit rot, 4.Wilts, 5. Choanephora blight 6. Bacterial leaf spot 7. Mosaic, 8. Leaf Curl
20-21	Cucurbits	1.Powdery and Downy mildew, 2.Wilts¸ 3.Angular leaf spot, 4.Mosaic 5. Gummy stem blight
	Cruciferous vegetables	1. Damping off /wire stem, 2.Club root, 3.Black spot 4.White rust, 5. Black rot
22	Onion and Garlic	1. Purple blotch, 2.Downy mildew, 3.Smut, 4. Smudge, 4.Neck rot 5.Twister blight, 6.Storage rots
	Carrot	1.Cercospora leaf blight, 2.Soft rot
	Colocasia	1.Phytophthora blight
23-24	Beans	1. Anthracnose, 2.Web blight, 3.Bacterial blight, 4.Rust, 5.BCMV, 6.Yellow mosaic
	Peas	1.Powdery mildew, 2.Downy mildew, 3.Anthracnose, 4.Aschochyta blight 5. Wilts 6.Rust, 7.Pea enation mosaic
	Okra	1.Cercospora leaf spot, 2.Yellow vein mosaic 3. Leaf enation
25	Leafy vegetables	1. White rust, 2.Downy mildew, 3.Damping off
	Moringa	1. Twig canker
	Coriander	1.Wilt 2.Stem gall 3. Powdery mildew
	Ginger	1. Phyllosticta leaf spot, 2.Soft rot
26	Turmeric	1. Leaf Spot, 2.Taphrina leaf blotch 3. Rhizome rot
27	Clove	1.Sudden death
	Cinnamon	1. Bark canker
	Cardamom	1. Azhkul rot 2.Katte mosaic, 3.Foorkey, 4.Chirkey disease
28	Rose	1. Dieback, 2.Powdery mildew, 3.Black Spot, 4.Mosaic, 5.Crown gall
29	Marigold	1. Alternaria leaf & flower blight, 2.Leaf spots
	Jasmine	1.Rust, 2.leaf spots, 3.Mosaic
30	Crossandra	1. Wilt
	Chrysanthemum	1. Septoria blotch, 2.Stunt
	Aster	1.Yellows
31	Gerbera	1. Ascochyta leaf spot, 2.Blossom blight or stalk rot
	Tuberose	1. Alternaria blight, 2.Erwinia blight
	Gladiolus	1. Corm rot, 2. Wilt
32		Integrated management of post harvest diseases of mango, Sweet Orange, Pomegranate, Apple, Grape, Banana, tomato, brinjal, chilli, potato, Onion and garlic, Cucurbits

Practicals:

To study the symptoms, etiology, host - pathogen interaction and specific management measures of different diseases of horticultural crops:

1. Study of diseases in Mango, Banana and Citrus
2. Study of diseases in Papaya, Guava and Pomegranate and Jack fruit
3. Study of diseases in Apple, Peach, Anola and Pine apple
4. Study of diseases in Coconut, Areca nut and Oil palm
5. Study of diseases in Coffee, Tea, Cocoa, Betel vine and Black Pepper
6. Study of diseases in Tomato and Potato
7. Study of diseases in Brinjal and Chilli
8. Study of diseases in Crucifers and Cucurbits
9. Study of diseases in Peas and Beans
10. Study of diseases in Coriander, Onion and Garlic
11. Study of diseases in Ginger, Turmeric

12. Diseases of Chrysanthemum, Crossandra, Jasmine, Rose, Tuberose
13. Acquaintance with fungicides, Antibiotics and Biopesticides and their use in management of diseases of horticultural crops
14. Field visit
15. Identification and histo pathological studies of selected diseases of horticultural crops covered in theory.
16. Field visit

Collection and preservation of plant diseased specimens for herbarium
Students should submit pressed and well mounted specimens.

References:

- Plant Diseases (By: RS Singh)
- Plant Disease Management: Principles and Practices (By: Hriday Chaube)
- Integrated Plant Disease Management (By: RC Sharma)
- Plant Pathology (By: GN Agrios)
- Pathak, V N Essentials of Plant Pathology Prakash Pub, Jaipur
- Kamat, M N Introductory Plant Pathology Prakash Pub, Jaipur
- Singh RS Introduction to Principles of Plant Pathology Oxford and IBH Pub Co
- Alexopoulos, Mims and Blackwel Introductory Mycology
- Mehrotra RS & Aggarwal A Plant Pathology th Ed Tata Mc Graw Hill Publ Co Ltd
- Gibbs A & Harrison B Plant Virology - The Principles Edward Arnold, London
- Hull R Mathews Plant Virology Ed Academic Press, New York
- Verma JP The Bacteria Malhotra Publ House, New Delhi
- Goto M Fundamentals of Plant Bacteriology Academic Press, New York
- Dhingra OD & Sinclair JB Basic Plant Pathology Methods CRC Press, London, Tokyo
- Nene YL & Thapliyal PN Fungicides in Plant Disease Control rd Ed Oxford & IBH, New Delhi
- Vyas SC Handbook of Systemic Fungicides Vols I-III Tata McGraw Hill, New Delhi
- Rajeev K & Mukherjee RC Role of Plant Quarantine in IPM Aditya Books

Course No.: ENMJ-2.6.1

Course Title: PEST MANAGEMENT OF HORTICULTURE CROPS-3 (2+1)

Lecture Outlines:

Theory:

1. Introduction and Economic classification of Insects

2. Study of insect pests (Distribution, host range, biology, Nature of damage and management) in horticultural crops

TROPICAL FRUITS- Mango: Hoppers, red banded caterpillar, nut weevil, stem borer, leaf webber, mealybug, fruit fly, leaf gall midges, thrips

3. **Guava:** Tea mosquito bug, fruit fly, fruit borer, mealybug, bark eating caterpillar; **Sapota:** Leaf webber, bud borer, fruit fly, seed borer.

4. **Ber:** Ber fruit fly, fruit borer, ber weevil; **Banana:** Rhizome weevil, pseudostem borer, aphid, skipper.

5. **Papaya:** Mealybug, spiralling whitefly, aphids; **Pomegranate:** Pomegranate butterfly, fruit borer, fruit sucking moths, thrips.

6. **Grapevine:** Flea beetle, thrips, stem girdler, mealy bug, stem borer, two spotted spider mite; **Litchi:** Fruit borer, leaf miner, rust mite

7. **Citrus:** Citrus butterfly, fruit sucking moths, citrus leaf miner, psylla, whitefly, blackfly, mite, bark eating caterpillar.

8. **TEMPERATE FRUITS:** Sanjose scale, woolly aphid, cottony cushion scale, codling moth, tent caterpillar, gypsy moth, European red mite, Peach Leaf curl aphid, borer; Plum weevil; Apricot chalcid

9. **PLANTATION CROPS Cashew:** Cashew shoot and root borer, shoot and blossom webber, tea mosquito bug, thrips, leaf miner, fruit borer;

10. **Coconut & Oil palm:** Black headed caterpillar, rhinoceros beetle, red palm weevil, Eriophyid mite, coconut scale, spiralling whitefly and other invasive pests.

11. **Cocoa:** Tea mosquito bug, chaffer beetle, bark eating caterpillar **Areca nut:** Scales, mites, thrips, nymphalid butterfly.

12. **Tea:** Tea mosquito bug, thrips, mite complex (red spider mite, yellow mite, pink mite, purple mite, scarlet mite); **Coffee:** Green scales, white borer, red borer, shot hole borer, berry borer.

13. & 14 **Medicinal and Aromatic Plants: Neem**: Root grub, slug caterpillar, mired bug, mealy bug, tea mosquito bug; **Crotalaria *Sp.***: Sun hemp hairy caterpillar **Cinnamon**: Leaf eating caterpillar, Jumping bug **Camphor**: Leaf roller, mealy bug, scales. **Mint**: Leaf roller, hairy caterpillars; **Datura**: Spotted borer, thrips; **Opium**: Cutworm, capsule borer, weevil. **Ashwagandha:** Hadda beetle, Tomato fruit borer, serpentine leaf miner, green stink bug. **Sarpagandha**: The lablab bug, grasshopper, curculionid weevil and sphingid.

15. **VEGETABLES: Brinjal:** Shoot and fruit borer, stem borer, Epilachna beetle, leaf hoppers, aphids, lace wing bug, mealybugs, leaf webber, red spider mite.

16. **Tomato:** fruit borer, serpentine leaf miner, whitefly, pin worm; **Bhendi:** spotted boll worms, jassid, whitefly, red cotton bug, dusky cotton bug;

17. **Cucurbits:** fruit files, pumpkin beetles, aphids, snake guard semi looper, pumpkin leaf caterpillar, coccinia gall fly, serpentine leaf miner

18. **Crucifers:** Diamond back moth, Cabbage head borer, Cabbage leaf webber, Cabbage semi looper, Painted bug, Aphids, Cabbage butterfly, Tobacco caterpillar

19. **Potato:** Potato tuber moth, black cut worm, bihar hairy caterpillar, Epilachna beetle, Golden cyst nematode: **Sweet Potato:** Sweet potato weevil, Vine borer, Tortoise beetle.

20. **Carrot and Beetroot:** Pea leaf miner, Flea beetle, Carrot rust fly, Web worm; **Colocasia:** Flea beetle, Grass hopper **Yams:** Yam beetles, Saw fly, Leaf eating caterpillars, Scale insects.

21. **Moringa:** Hairy caterpillar, Bud worm, Bud midge, Leaf caterpillar, Scale, Pod fly, Bark eating caterpillar; **Peas and Beans:** Pea leaf miner, Pea stem fly, Pea pod borer, Gram pod borer,
Flower webber, Bean aphid, Leaf hopper.

22. **Leafy vegetables:** Amaranthus caterpillar, Leaf webber, Stem weevil; Palak & Spinach Leaf eating caterpillar and Aphids; **Curry leaf:** Psyllid bug, Citrus butterfly, bark borer.

23. **FLOWER & ORNAMENTAL CROPS - Rose:** Rose aphid, Thrips, Scales, Leaf cutter bee, Tomato fruit borer.

24. **Jasmine:** Bud worm, Gallery worm, Blossom midge, Eriophyid mite, Jasmine thrips, Stink bug.

25. **Chrysanthemum:** Black aphid, Composite thrips, Leaf folder, Tomato fruit borer, Leaf miner; **Marigold:** Tomato fruit borer, Leaf hopper, Hairy caterpillar, Tarnished plant bug Red spider mite.

26. **Pests of cut flowers:** Lily leaf caterpillar, Gladiolus thrips, Carnation tortrix moth, Tuberose bulb mite, Gerbera mite, Bird of paradise scale, Dahlia aphid, Orchid weevil, Orchid bulb mite and orchid fly, Tulip bulb aphid, Green peach aphid in anthurium.

27. **SPICES - Pepper:** Pollu beetle, top shoot borer, berry gall midge, hard scales, soft scale, two tailed mealy bug, wild silkmoth.

28. **Cardamom:** Cardamom aphid, Cardamom thrips, Castor Capsule borer, shoot borer, Cardamom hairy caterpillars; Fenugreek lucerne caterpillar;

29. **Chillies:** Chilli thrips, Fruit borers, Fruit bug, cotton whitefly, Termite, mites, blossom midge.

30. **Onion & Garlic:** Onion fly, ear wig, onion thrips, tomato fruit borer, tobacoo caterpillar, cutworms; **Turmeric and Ginger**: Rhizome Fly, Rhizome scales, shoot borer.

31. Pests of Stored Products - Cigarette beetle, Lesser grain borer, Khapra beetle, Tamarind beetle, Drug store beetle, Dried fruit moth, sweet potato weevil, potato tuber moth, red flour beetle, rice moth, Indian meal moth, Dried current moth, almond moth, dried fruit beetle, saw toothed beetle

32. Pesticide residues problem in horticultural crops and their management.

Practicals:

1. Calculation of insecticidal doses/ concentrations of different formulations.
2. Identification of insects and damage symptoms of pests of mango,
3. Identification of insects and damage symptoms of pests of guava, sapota
4. Identification of insects and damage symptoms of pests of ber, banana, papaya
5. Identification of insects and damage symptoms of pests of pomegranate, grapevine and citrus
6. Identification of insects and damage symptoms of pests of cashew, cocoa
7. Identification of insects and damage symptoms of pests of coconut, oil palm
8. Identification of insects and damage symptoms of pests of tea, coffee
9. Identification of insects and damage symptoms of pests of medicinal and aromatic plants
10. Identification of insect pests of brinjal, bhendi and tomato and their damage symptoms.
11. Identification of insect pests of cucurbits and crucifers their damage symptoms
12. Identification of insect pests of tuber crops and their damage symptoms
13. Identification of insect pests of peas, beans, moringa, spinach and amaranthus and their damage symptoms
14. Identification of insect pests of rose, jasmine, crossandra, cut flowers, marigold and chrysanthemum and their damage symptoms
15. Identification of insect pests of pepper and cardamom, chillies, onion and garlic and their damage symptoms
16. Identification of insects and damage symptoms of pests of stored products.

References

- David B.V. and Ramamurthy, V.V 2001. Elements of Economic Entomology. Popular Book Depot, Chennai.
- Dhaliwal GS, Singh R & Chhillar BS. 2006. Essentials of Agricultural Entomology. Kalyani Publ., New Delhi.
- Introduction to Insect pest management, Metcalf, R.L and Luckman, W.H. 1982. Wiley Inter Science Publishing, New York
- Insects and Fruits, Butani, D.K. 1984. Periodical Expert Book Agency, New Delhi
- P. Srivastava, Dhamo K. Butani Pest management in vegetables – Part1. Research Book Centre, 1998
- K.P. Srivastava. A Text Book on Applied Entomology Vol. I&II. , Kalyani Publishers, Ludhiyana
- Emmanuel, N, A. Sujatha, T.S.K. K. Kiran Patro, MLN Reddy, B. Srinivasulu, TSSK Patro. Text Book on Integrated Pest Management of Horticultural Crops.Astral International Publishers, New Delhi.

Course No.: VSMJ-2.2.3

Course Title: Precision farming and protected cultivation -2(1+1)

Lecture outlines
Theory

S.No	Topic
1	Introduction to Precision Farming- Definition, Scope, and Concepts. Key Terminology in Precision Farming- Global Positioning System (GPS), Differential GPS (DGPS), Geographic Information System (GIS), Remote Sensing, Applications in crop monitoring, soil assessment, and detecting variability in fields, Robotics in horticulture
	Protected cultivation: importance and scope. Current status of protected cultivation in India. Problems / constraints of greenhouse cultivation and future strategies.
2	Classification of protected structures- green house, poly house, net house, poly tunnels, and screen house, rain shelters, protected nursery house, Vegetable grafting sheds
3&4	Planning and design of greenhouses, Design criteria of greenhouse for cooling and heating purposes. Typical applications, passive solar green house, hot air greenhouse heating systems, green house drying.
5&6	Green house equipment, materials of construction for traditional and low cost green houses.
7&8	Soil culture, type of soil required, drainage, flooding and leaching, soil pasteurization.
9&10	Soil less culture-Advantages, Disadvantages. Types of growing media, in peat moss and mixtures, rock wool and other inert media. NFT, Hydroponics and aeroponics.
11	Plant response to Greenhouse environment.
12&13	Irrigation and fertigation systems used in green houses.
14	Hi-tech protected cultivation, plant protection and post harvest handling techniques for Tomato.
15	Hi-tech protected cultivation, plant protection and post harvest handling techniques for Capsicum.
16	Hi-tech protected cultivation, plant protection and post harvest handling techniques for Cucumber.

Practical	Topic
1	Study of different types of greenhouses based on shape, construction and cladding materials
2	Calculation of air rate exchange in an active summer winter cooling system
3	Calculation of rate of air exchange in an active winter cooling system
4	Estimation of drying rate of agricultural products inside green house
5	Soil sampling and testing to study its suitability for growing crops in greenhouses
6	Practicing soil fumigation in greenhouses for cultivation of crops
7	Water sampling and testing the quality of water to study its suitability for growing crops in greenhouses
8	Study of fertigation requirements for greenhouse crops
9	Study on estimation of E.C. in the fertigation solution
10	Study of various growing media used in raising of greenhouse crops
11	Preparation of growing media for raising greenhouse crops
12	Pasteurization / sterilization of growing media
13	The study on pro-trays based nursery raising
14	Visit to commercial green houses
15	Visit to Hi tech nursery
16	Study of the Economics of protected cultivation

Reference

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

• Brahma S 2019.Precision Farming and Protected Cultivation. NIPA, New Delhi.

Course No.: SPMJ-2.4.1

Course Title: Commercial Production of Medicinal and Aromatic crops-2 (1+1)

Lecture Outlines:

Theory:

1. Introduction: History, importance, present status (export & import), future prospects and constraints in the cultivation of medicinal and aromatic plants. Research institutes working on medicinal and aromatic plants- National, AICRP, Directorates.
2. Aloe: Importance and uses, chemical composition, origin and distribution, description of plant, species and varieties, area and production, soil and climate, land preparation, propagation and nursery techniques, planting and after care, irrigation, nutrition, inter cultural operations, harvesting and yield.
3. Ashwagandha: Importance and uses, chemical composition, origin and distribution, description of plant, species and varieties, area and production, soil and climate, land preparation, propagation and nursery techniques, planting and after care, irrigation, nutrition, inter cultural operations, harvesting and yield.
4. Dioscorea: Importance and uses, chemical composition, origin and distribution, description of plant, species and varieties, area and production, soil and climate, land preparation, propagation and nursery techniques, planting and after care, irrigation, nutrition, inter cultural operations, intercropping, staking, harvesting and yield.
5. Isabgol and Kalmegh: Importance and uses, chemical composition, origin and distribution, description of plant, species and varieties, area and production, soil and climate, land preparation, propagation and nursery techniques, planting and after care, irrigation, nutrition, cultural operations, plant protection, harvesting and yield.
6. Opium poppy: Importance and uses, chemical composition, origin and distribution, description of plant, species and varieties, area and production, soil and climate, land preparation, propagation, planting and after care, irrigation, nutrition, inter cultural operations, lancing and latex collection, harvesting and yield of seed and crude opium.
7. Periwinkle: Importance and uses, chemical composition, origin and distribution, description of plant, species and varieties, area and production, soil and climate, land preparation, propagation and nursery techniques, planting and after care, irrigation, nutrition, inter cultural operations, harvesting and yield,
8. Sarpagandha: Importance and uses, chemical composition, origin and distribution, description of plant, species and varieties, area and production, soil and climate, land preparation, propagation, planting and after care, irrigation, nutrition, inter cultural operations, harvesting and yield.
9. Senna: Importance and uses, chemical composition, origin and distribution, description of plant, species and varieties, area and production, soil and climate, land preparation, propagation and nursery techniques, planting and after care, irrigation, nutrition, inter cultural operations, harvesting and yield.
10. Ambrette (musk) Importance and uses, origin and distribution, description of plant, species and varieties, area and production, soil and climate, land preparation, propagation and nursery techniques, planting and after care, irrigation, nutrition, inter cultural operations, plant protection, harvesting and yield.
11. Description of plant, classification and varieties of Aromatic grasses - Citronella, Lemon grass, Palmarosa and Vetiver
12. Citronella and Lemon grass – Importance and uses, origin and distribution, area and production, soil and climate, land preparation, propagation, planting and after care, irrigation, nutrition, cultural operations, harvesting and yield of herb and oil.
13. Palmarosa and Vetiver - Importance and uses, origin and distribution, area and production, soil and climate, land preparation, propagation, planting and after care, irrigation, nutrition, cultural operations, harvesting and yield of herb and oil.
14. Ocimum: Importance and uses, origin and distribution, description of species and varieties, area and Production, Soil and climate, land preparation, propagation, planting and after care, irrigation, nutrition, inter cultural operations, harvesting and yield.
15. Patchouli: Importance and uses, origin and distribution, varieties, description of plant, area and production, soil and climate, land preparation, propagation, planting and after care, irrigation, nutrition, inter cultural operations, harvesting and yield.

16. Common name, scientific name, family, economic part, uses, propagation of Medicinal Crops – Cinchona, Pyrethrum, Belladonna, *Ammi majus*, *Tinospora*, Brahmi, Liquorice, Glori lilly, Bhumalakai and Aromatic Crops – Mint, Davana, Geranium, Maruvam, Eucalyptus, Guggal, Bursera, Sandalwood, Sweet flag

Practical:

1. Identification of Medicinal crops
2. Identification of Aromatic crops
3. Collection and identification of seed samples from medicinal and aromatic crops
4. Propagation and nursery techniques for Dioscorea and Ashwagandha
5. Propagation and nursery techniques for Sarpagandha and Kalmegh
6. Maturity indices and harvesting of Aloe, Ashwagandha, Dioscorea, Isabgol
7. Maturity indices and harvesting of Kalmegh, Periwinkle, Sarpagandha, Senna
8. Maturity indices, lancing, latex collection and yield of Opium
9. Propagation and nursery techniques for important aromatic plants
10. Maturity indices and Harvesting techniques for important aromatic plants
11. Study on methods of extraction of essential oils
12. Study on extraction methods of drug and alkaloid from medicinal plants
13. Visit to Ayurvedic pharmacy,
14. Visit to commercial perfumery
15. Visit to research station / farmers field on medicinal and aromatic plants
16. Collection of locally available Medicinal and Aromatic plants, plant description and preparation of herbarium (minimum 15)

References

- Kumar N 2018. Introduction to spices plantation crops medicinal and aromatic plants. Oxford and IBH publishing Co. Pvt. Ltd, New Delhi.
- Farooqi & Sreenivas 2022 Cultivation of Medicinal & Aromatic Crops. Universities Publication, Hyderabad

Course No.: FRSE-2.1.1

Course Title: Nursery Production in Horticulture crops -2 (0+2)

Lecture Outlines:

1. Preparation of Layout of model nursery
2. Tools and equipment-identification and application in nursery.
3. Methods of seed Extraction and storage of healthy seeds in horticulture crops
4. Methods of seed treatments for germination and protection
5. Study of Soil solarisation
6. Study of Media sterilization
7. Preparation of different types of nursery Seed beds
8. Media characteristics and Preparation of growing media
9. Identification and raising of rootstocks for different fruit plants
10. Study of seedling and clonal root stocks
11. Preparation of potting mixtures.
12. Potting, de potting and repotting.
13. Calculation and Preparation of plant growth regulators for seed germination and vegetative propagation.
14. Forms of growth regulators and methods of application
15. Selection of scion material for grafting
16. Practicing methods of cuttage
17. Practicing methods of layerage
18. Practicing methods of grafting.
19. Practicing methods of budding.
20. Micro propagation-explant preparation, media preparation
21. Culturing– meristem tip culture, axillary bud culture
22. Micro grafting and hardening of plants.
23. Nursery techniques: Clipping, cutting, defoliation, de blossoming, de shooting, pricking, disbudding, pinching.

24. Nursery management practices i.e. weed control, irrigation, nutrition, etc.
25. Protection of nursery plants against adverse climatic conditions.
26. Study of Protected structures.
27. Diagnosis and control of important diseases and pests in the nursery,
28. Lifting and packing and labelling of nursery plants
29. Hardening of nursery plants
30. Visit to commercial tissue culture laboratories and accredited nurseries.
31. Nursery Accreditation.
32. Nursery registration act

References:

- Davies F T Geneve R L and Wilson S B 2018. Hartmann and Kester's Plant Propagation Principles and Practices 9th Edition Pearson. USA.
- Sharma R R and Krishna H 2017. Textbook of Plant Propagation and Nursery Management. C B S Publishers. New Delhi.
- Sharma R R and Srivastava M 2004. Plant Propagation and Nursery Management. IBDC Publishers. New Delhi
- National horticulture board, Government of India.
- Andhra Pradesh Horticulture nurseries registration Act

Course No.: VSSE-2.2.1

Course Title: Seed production in vegetable and flower crops - 2 (0+2)
Lecture outlines
Practical

S.No	Topic
1	Floral biology, pollination and breeding behavior of Solanaceous and Cucurbitaceous vegetable crops
2	Floral biology, pollination and breeding behavior of Rose, Marigold, Chrysanthemum)
3	Floral biology, pollination and breeding behavior of Gerbera, Hibiscus, Jasmine and Petunia)
4	Floral biology, pollination and breeding behavior of Leafy vegetables (Amaranthus, Palak, Coriander and Fenugreek)
5	Floral biology, pollination and breeding behavior of Legumes (Common bean, Cluster bean, Cow pea and French bean)
6- 7	Emasculation and pollination techniques
8	Seed certification standards, Study of seed classes, tags, labeling and packing
9	Planning and layout of seed production plot
10	Pre sowing seed treatment with chemical and biological agents
11	Sowing/Raising nursery for seed production
12	Raising and maintenance of seed production plot
13	Preparation of PGR solutions and use of PGRs in seed production
14	Field inspection and field counting procedures to conform to prescribed field standards at different growth stages.
15	Seed maturity and harvesting methods (Flowering annuals and vegetable crops)
16	Seed extraction in different crops.
17	Seed cleaning, seed treatment, grading and packing material
18	Seed storage methods-Storage pest/disease management
19	Seed sampling procedure and equipments used for seed sampling
20	Seed quality testing, seed quality standards and equipments used for seed quality testing

21	Seed purity analysis.
22	Seed germination tests
23	Seed viability tests.
24	Seed vigour tests.
25	Seed moisture testing
26	Testing seed for genetic purity
27	Book keeping- maintenance of different records and registers for seed production
28	Visit to government seed production farms
29	Visit to private seed production farms
30	Visit to seed processing plant
31	Visit to Commercial seed processing plant
32	Visit to seed testing laboratory

References

- Sreenivasa Rao,E, Varalakshmi, B , Naresh P, Pal S.(2024).Commercial Breeding and Seed Production of Vegetable Crops. NIPA Publishers, New Delhi.
- Dadlani, M., and Yadava, D. K. (2023). Seed Science and Technology: Biology, Production, Quality (p. 430). Springer Nature.
- Pradeep kumar and Divya K. Lekshmanan (2023)-Seed Production Technology of Vegetable, Tuber and Spice Crops-NIPA book publishers
- Vanangamudi, K. (2020). Seed Science and Technology 2nd Edition . ABH Publisers
- Shankar Lal.(2018).Principles and Practices of Seed Production of Vegetables Crops.Today and Tomorrow Printers and Publishers
- Ram Hari Har, Upadhyay Rupa, Dubey R K and Mandal B C. (2017). Vegetable seed production- Principles and practices. Kalyani Publishers, Ludhiana.
- George, R. A. (2009). Vegetable seed production. CABI.
- Hazra P and. Som M G. (2009). Vegetable seed production and Hybrid Technology. Kalyani Publishers, Ludhiana.
- Mishra, N., Panigrahi, K. K., & Mani, A. (2004). A Text Book on Vegetable Seed Production. International Books & Periodicals Supply Service.
- Arya, Prem Singh. (2003). Vegetable seed Production Principles. Kalyani Publishers. Ludhiana.
- Sen Subip and Ghosh Nabinanda,(2002). Seed Science and Technology, Kalyani,Publishers, Ludhiana
- Kulkarni, G.N.(2002).Principles of Seed Technology, Kalyani Publishers, Ludhiana.
- Singh, S P. (2001). Seed production of commercial vegetables. Agro tech Publishing, Udaipur
- Agrawal, R.L. (1996).Seed Technology, Oxford and IBH Publicity Company, New Delhi.
- Nema, N.P., (1986), Principles of Seed Certification and Seed Testing, Allied Publishers Private limited, New Delhi.

Course No.: FLSE-2.3.3

Course Title: Dry flower technology -2 (0+2)

Lecture Outlines:

1. Dry flowers –definition, importance, scope of dry flowers at global and Indian scenario, export potential, dry flower units.

2. Identification and selection of flowers and plant parts for dry flower making.

3. Collection of plant material for dry flower making.

4. Selection of stages for picking of flowers for drying.

5. Techniques in dry flower making –drying (Natural drying, air drying, sun drying).

6. Techniques in dry flower making –Pressing.

7. Techniques in dry flower making –embedded drying (Borax, sand, silica gel).

8. Techniques in dry flower making –Hot air oven drying.

9. Techniques in dry flower making –microwave oven drying.

10. Techniques in dry flower making –glycerine drying.

11. Techniques in dry flower making –freeze drying.

12. Techniques in dry flower making –bleaching.

13. Techniques in dry flower making –dyeing.

14. Preparation of dry flower baskets.

15. Preparation of dry flower boquets.

16. Preparation of dry flower wreaths.

17. Preparation of wall hangings.

18. Preparation of button holes and dry flower glass jars.

19. Preparation of dry flower candles.

20. Preparation of dry flower incense sticks.

21. Preparation of dry flower greeting cards and book marks.

22. Preparation of dry flower photo frames.

23. Preparation of dry flower wall hangings.

24. Preparation of petal embedded hand made papers.

25. Preparation of resin dry flower arts-key chains, pendants, ornaments.

26. Preparation of herbal gulals.

27. Preparation of floral teas.

28. Preparation of pot pourries.

29. Use of flower waste as feed supplement.

30. Physiological changes after drying.

31. Post drying management including moisture, pests and molds.

32. Visit to dry flower units.

References

- S.K. Bhattacharjee and L.C. De. 2003. *Advanced Commercial Floriculture*. Aavishkar Publishers, Distributors, Jaipur (Rajasthan) India.
- Randhawa, G.S. Amitabha Mukhopadhyay, 2004. Floriculture in India. Allied Publishers Pvt. Ltd
- Arora, J.S. 2006. Introductory Ornamental Horticulture. Kalyani Publishers, Ludhiana - 141 008.
- Prof. Bhattacharjee, S.K. Advanced Commercial Floriculture. Aavishkar Publishers Distributors, Jaipur - 320 003

Course No.: PHSE-2.5.1

Course Title: Post-harvest management of Horticultural crops-2 (0+2)

Lecture Outlines:

1.	Practice in judging the maturity of various horticultural produce
2.	Judging maturity by different methods Computational, Physical, Chemical, physiological and other methods
3-4.	Tools for Manual and Mechanical harvesting
5.	Objective measurement of color, texture and dry matter
6.	Different types of cleaning agents and washing methods for horticultural produce
7.	Layout of pack house and general pack house operations
8 - 9.	Determination of physiological loss in weight and quality of fruits and vegetables
10.	Significance of Sorting and Grading in Horticulture produce Grading of Horticultural produce manual and mechanical
11.	Grading standards of Fruits and Vegetables
12.	Pre-cooling of Horticultural produce
13.	Postharvest treatment of Horticultural crops, physical and chemical methods
14.	Packaging methods in Horticultural crops
15.	Ripening methods
16 -17.	Extension of shelf-life studies of fresh produce
18	Pesticide residue and heavy metal toxicity in Horticultural produce
19.	Storage requirements of different Horticultural crops
20.	Cold-chain management
21.	Estimation of moisture content in fresh Fruits and Vegetables for storage
22.	Post harvest disorders in Horticultural crops
23.	Post harvest Storage diseases in Horticultural crops
24.	Post harvest handling of Cut flowers
25.	Pulsing and tinting of flower and Ornamental crops
26-27.	Vase life extension of Flowers
28-29.	Visit to Fruit and Vegetable markets
30.	Visit to Ripening unit
31-32.	Visit to Pack houses and Cold storages

References:

- Post harvest technology of Fruits and Vegetables - Thompson, A.K.1996. Blackwell science, London.
- Principles and practice of Post harvest technology Pandey, P.H.1998. Kalyani Publishers, Ludhiana.
- Post harvest technology of Horticultural crops. Sudheer, K.P.2007 New India, Publishing Agency, New Delhi
- Physiology and Post harvest management of Horticultural crops - Singh, D. K. 2001. Pointer, Jaipur

- Post harvest management of Horticultural crops - Mir, M. A. 2005. Agro tech Publishing agency, Udaipur. Rajasthan, India.
- Post harvest physiology of perishable plant products – Kays and Stanely, J.1998. CBS Publishers & Distributors, New Delhi.
- Fruit and Vegetable processing – Bhatti Suman1995.Vame, B S Publishers & Distributors, New Delhi
- Post Harvest Management of Horticultural Crops -Saraswathy, S. Preethi, T. L. Bala Subramanian, S. Suresh J. Revathy, N and Natarajan, S.2007. Agrotech Publishing Agency, Udaipur.

SKILL ENHANCEMENT COURSES-IV

Course No.: FRSE-2.1.1

Course Title: Nursery Production in Horticulture crops-2 (0+2)

Lecture Outlines:

1. Preparation of Layout of model nursery
2. Tools and equipment-identification and application in nursery.
3. Methods of seed Extraction and storage of healthy seeds in horticulture crops
4. Methods of seed treatments for germination and protection
5. Study of Soil solarisation
6. Study of Media sterilization
7. Preparation of different types of nursery Seed beds
8. Media characteristics and Preparation of growing media
9. Identification and raising of rootstocks for different fruit plants
10. Study of seedling and clonal root stocks
11. Preparation of potting mixtures.
12. Potting, de potting and repotting.
13. Calculation and Preparation of plant growth regulators for seed germination and vegetative propagation.
14. Forms of growth regulators and methods of application
15. Selection of scion material for grafting
16. Practicing methods of cuttage
17. Practicing methods of layerage
18. Practicing methods of grafting.
19. Practicing methods of budding.
20. Micro propagation-explant preparation, media preparation
21. Culturing– meristem tip culture, axillary bud culture
22. Micro grafting and hardening of plants.
23. Nursery techniques: Clipping, cutting, defoliation, de blossoming, de shooting, pricking, disbudding, pinching.
24. Nursery management practices i.e. weed control, irrigation, nutrition, etc.
25. Protection of nursery plants against adverse climatic conditions.
26. Study of Protected structures.
27. Diagnosis and control of important diseases and pests in the nursery,
28. Lifting and packing and labelling of nursery plants
29. Hardening of nursery plants
30. Visit to commercial tissue culture laboratories and accredited nurseries.
31. Nursery Accreditation.
32. Nursery registration act

References:

- Davies F T Geneve R L and Wilson S B 2018. Hartmann and Kester's Plant Propagation Principles and Practices 9th Edition Pearson. USA.
- Sharma R R and Krishna H 2017. Textbook of Plant Propagation and Nursery Management. C B S Publishers. New Delhi.
- Sharma R R and Srivastava M 2004. Plant Propagation and Nursery Management. IBDC Publishers. New Delhi
- National horticulture board, Government of India.
- Andhra Pradesh Horticulture nurseries registration Act

Course No.: VSSE-2.2.1

Course Title: Seed production in vegetable and flower crops -2 (0+2)

Practical outlines

S.No	Topic
1	Floral biology, pollination and breeding behavior of Solanaceous and Cucurbitaceous vegetable crops
2	Floral biology, pollination and breeding behavior of Rose, Marigold, Chrysanthemum)
3	Floral biology, pollination and breeding behavior of Gerbera, Hibiscus, Jasmine and Petunia)
4	Floral biology, pollination and breeding behavior of Leafy vegetables (Amaranthus, Palak, Coriander and Fenugreek)
5	Floral biology, pollination and breeding behavior of Legumes (Common bean, Cluster bean, Cow pea and French bean)
6- 7	Emasculation and pollination techniques
8	Seed certification standards, Study of seed classes, tags, labeling and packing
9	Planning and layout of seed production plot
10	Pre sowing seed treatment with chemical and biological agents
11	Sowing/Raising nursery for seed production
12	Raising and maintenance of seed production plot
13	Preparation of PGR solutions and use of PGRs in seed production
14	Field inspection and field counting procedures to conform to prescribed field standards at different growth stages.
15	Seed maturity and harvesting methods (Flowering annuals and vegetable crops)
16	Seed extraction in different crops.
17	Seed cleaning, seed treatment, grading and packing material
18	Seed storage methods-Storage pest/disease management
19	Seed sampling procedure and equipment used for seed sampling
20	Seed quality testing, seed quality standards and equipment used for seed quality testing
21	Seed purity analysis.
22	Seed germination tests
23	Seed viability tests.
24	Seed vigour tests.
25	Seed moisture testing
26	Testing seed for genetic purity
27	Book keeping- maintenance of different records and registers for seed production
28	Visit to government seed production farms
29	Visit to private seed production farms
30	Visit to seed processing plant
31	Visit to Commercial seed processing plant
32	Visit to seed testing laboratory

References

- Sreenivasa Rao,E, Varalakshmi, B , Naresh P, Pal S.(2024).Commercial Breeding and Seed Production of Vegetable Crops. NIPA Publishers, New Delhi.
- Dadlani, M., and Yadava, D. K. (2023). Seed Science and Technology: Biology, Production, Quality (p. 430). Springer Nature.

- Pradeep kumar and Divya K. Lekshmanan (2023)-Seed Production Technology of Vegetable, Tuber and Spice Crops-NIPA book publishers
- Vanangamudi, K. (2020). Seed Science and Technology 2nd Edition . ABH Publisers
- Shankar Lal.(2018).Principles and Practices of Seed Production of Vegetables Crops.Today and Tomorrow Printers and Publishers
- Ram Hari Har, Upadhyay Rupa, Dubey R K and Mandal B C. (2017). Vegetable seed production- Principles and practices. Kalyani Publishers, Ludhiana.
- George, R. A. (2009). Vegetable seed production. CABI.
- Hazra P and. Som M G. (2009). Vegetable seed production and Hybrid Technology. Kalyani Publishers, Ludhiana.
- Mishra, N., Panigrahi, K. K., & Mani, A. (2004). A Text Book on Vegetable Seed Production. International Books & Periodicals Supply Service.
- Arya, Prem Singh. (2003). Vegetable seed Production Principles. Kalyani Publishers. Ludhiana.
- Sen Subip and Ghosh Nabinanda,(2002). Seed Science and Technology, Kalyani, Publishers, Ludhiana
- Kulkarni, G.N.(2002).Principles of Seed Technology, Kalyani Publishers, Ludhiana.
- Singh, S P. (2001). Seed production of commercial vegetables. Agro tech Publishing, Udaipur
- Agrawal, R.L. (1996).Seed Technology, Oxford and IBH Publicity Company, New Delhi.
- Nema, N.P., (1986). Principles of Seed Certification and Seed Testing, Allied Publishers Private limited, New Delhi.

Course No.: FLSE-2.3.3

Course Title: Dry flower technology- 2 (0+2)

Lecture Outlines:

1. Dry flowers –definition, importance, scope of dry flowers at global and Indian scenario, export potential, dry flower units.

2. Identification and selection of flowers and plant parts for dry flower making.

3. Collection of plant material for dry flower making.

4. Selection of stages for picking of flowers for drying.

5. Techniques in dry flower making –drying (Natural drying, air drying, sun drying).

6. Techniques in dry flower making –Pressing.

7. Techniques in dry flower making –embedded drying (Borax, sand, silica gel).

8. Techniques in dry flower making –Hot air oven drying.

9. Techniques in dry flower making –microwave oven drying.

10. Techniques in dry flower making –glycerine drying.

11. Techniques in dry flower making –freeze drying.

12. Techniques in dry flower making –bleaching.

13. Techniques in dry flower making –dyeing.

14. Preparation of dry flower baskets.

15. Preparation of dry flower boquets.

16. Preparation of dry flower wreaths.

17. Preparation of wall hangings.

18. Preparation of button holes and dry flower glass jars.

19. Preparation of dry flower candles.

20. Preparation of dry flower incense sticks.

21. Preparation of dry flower greeting cards and book marks.

22. Preparation of dry flower photo frames.

23. Preparation of dry flower wall hangings.

24. Preparation of petal embedded handmade papers.

25. Preparation of resin dry flower arts-key chains, pendants, ornaments.

26. Preparation of herbal gulals.

27. Preparation of floral teas.

28. Preparation of pot pourries.

29. Use of flower waste as feed supplement.

30. Physiological changes after drying.

31. Post drying management including moisture, pests and molds.

32. Visit to dry flower units.

References

- S.K. Bhattacharjee and L.C. De. 2003. *Advanced Commercial Floriculture*. Aavishkar Publishers, Distributors, Jaipur (Rajasthan) India.
- Randhawa, G.S. Amitabha Mukhopadhyay, 2004. Floriculture in India. Allied Publishers Pvt. Ltd
- Arora, J.S. 2006. Introductory Ornamental Horticulture. Kalyani Publishers, Ludhiana - 141 008.
- Prof. Bhattacharjee, S.K. Advanced Commercial Floriculture. Aavishkar Publishers Distributors, Jaipur - 320 003

Course No.: PHSE-2.5.1

Course Title: Post-harvest management of Horticultural crops-2 (0+2)

Lecture Outlines:

1.	Practice in judging the maturity of various horticultural produce
2.	Judging maturity by different methods Computational, Physical, Chemical, physiological and other methods
3-4.	Tools for Manual and Mechanical harvesting
5.	Objective measurement of color, texture and dry matter
6.	Different types of cleaning agents and washing methods for horticultural produce
7.	Layout of pack house and general pack house operations
8 - 9.	Determination of physiological loss in weight and quality of fruits and vegetables

10.	Significance of Sorting and Grading in Horticulture produce Grading of Horticultural produce manual and mechanical
11.	Grading standards of Fruits and Vegetables
12.	Pre-cooling of Horticultural produce
13.	Postharvest treatment of Horticultural crops, physical and chemical methods
14.	Packaging methods in Horticultural crops
15.	Ripening methods
16 -17.	Extension of shelf-life studies of fresh produce
18	Pesticide residue and heavy metal toxicity in Horticultural produce
19.	Storage requirements of different Horticultural crops
20.	Cold-chain management
21.	Estimation of moisture content in fresh Fruits and Vegetables for storage
22.	Post harvest disorders in Horticultural crops
23.	Post harvest Storage diseases in Horticultural crops
24.	Post harvest handling of Cut flowers
25.	Pulsing and tinting of flower and Ornamental crops
26-27.	Vase life extension of Flowers
28-29.	Visit to Fruit and Vegetable markets
30.	Visit to Ripening unit
31-32.	Visit to Pack houses and Cold storages

References:

- Post harvest technology of Fruits and Vegetables - Thompson, A.K.1996. Blackwell science, London.
- Principles and practice of Post harvest technology Pandey, P.H.1998. Kalyani Publishers, Ludhiana.
- Post harvest technology of Horticultural crops. Sudheer, K.P.2007 New India, Publishing Agency, New Delhi
- Physiology and Post harvest management of Horticultural crops - Singh, D. K. 2001. Pointer, Jaipur
- Post harvest management of Horticultural crops - Mir, M. A. 2005. Agro tech Publishing agency, Udaipur. Rajasthan, India.
- Post harvest physiology of perishable plant products – Kays and Stanely, J.1998. CBS Publishers & Distributors, New Delhi.
- Fruit and Vegetable processing – Bhatti Suman1995.Vame, B S Publishers & Distributors, New Delhi
- Post Harvest Management of Horticultural Crops -Saraswathy, S. Preethi, T. L. Bala Subramanian, S. Suresh J. Revathy, N and Natarajan, S.2007. Agro tech Publishing Agency, Udaipur.

V SEMESTER COURSES

Course No : GPMN-3.8.1

Course Title : Principles of Genetics - 2 (2+0)

Lecture Outline

Theory

1. Introduction to genetics: historical background- Mendel's experiments on garden pea, reasons for selection of pea as experimental material, characters studied, reasons for Mendel's success.
2. Laws of inheritance: law of segregation, monohybrid ratios, concepts of dominance, unit characters, homozygous, heterozygous, phenotype, genotype and other terminology.
3. Law of independent assortment, dihybrid ratios, trihybrid ratios.

4. Deviation from Mendelian inheritance, co-dominance, incomplete dominance, lethal genes.
5. Structure of a eukaryotic cell, different cell organelles, euchromatin, heterochromatin.
6. Chromosomes: morphology of chromosomes – size, shape, number, structure, karyotype, ideogram.
7. Cell Division-Mitosis and Meiosis, different stages. Physical basis of inheritance/chromosomal theory of inheritance. Relationship between meiosis and Mendel's laws.
8. Multiple alleles, inheritance of blood groups, pleiotropism, threshold characters, penetrance and expressivity.
9. Gene interactions- complementary, supplementary interactions.
10. Gene interactions-inhibitory and duplicate interactions.
11. Gene interactions polymeric and masking effect. Inheritance of comb shape in chicken.
12. Introduction to quantitative genetics- Quantitative traits and Qualitative traits, Multiple factor hypotheses.
13. Cytoplasmic inheritance and maternal effects. Inheritance of male sterility in crop plants.
14. Linkage- Bateson and Punnets experiments- coupling and repulsion phases, Morgan's work in drosophila. Cis and trans phases.
15. Crossing over and recombination, significance.
16. Linkage maps, linkage groups, two-point test cross, three-point test cross
17. Physical maps, genetic maps, molecular maps
18. Discovery of DNA as the genetic material, experiments of Griffith; Avery, McCleod, and McCarthy; Hershey and Chase. RNA as the genetic material.
19. Structure of DNA, Watson & Crick model.
20. Replication of DNA, semi conservative replication of DNA with experimental proof
21. RNA-types (mRNA, tRNA, rRNA) their structure and function.
22. Central dogma of molecular biology, Genetic code, transcription and translation, protein synthesis.
23. Sex forms in plants, animals and insects. Sex determination mechanisms. Inheritance pattern of sex in papaya.
24. Sex linked traits, sex limited traits and sex influenced traits.
25. Mutations, characteristics of mutations, types of mutations- Point mutations and Gross mutations.
26. Structural chromosomal aberrations- deletions, duplications, inversions and translocations
27. Muller's experiment-detection of X linked recessive lethal mutations
28. Numerical chromosomal aberrations- aneuploids, haploids, euploids
29. Autopolyploid and allopolyploids
30. Molecular markers- RFLP, RAPD, AFLP
31. Molecular markers- SSR, ISSR, SNP
32. Application of knowledge of genetics in plant breeding

References:

- Benjamin A. Pierce 2003. Genetics a conceptual approach, Freeman and company, New York.
- Gupta, P.K 2007. Genetics, A book for Universities, Rastogi Publications, Meerut
- Gardner, E.J. and Snustad, D P 1984. Principles of Genetics (7th Edition), John Wiley and Sons, New York
- Miglani, G.S 2008. Fundamentals of Genetics, Narosa Publication House, New Delhi

Course No.: GPMN- 3.8.2

Course Tile: Principles of Biotechnology-2(1+1)

Lecture Outlines

Theory

1. Biotechnology definitions, major concepts scope and importance, National and International organizations involved in biotechnological research:
2. Introduction to Plant Tissue Culture: History, Cellular totipotency & cytodifferentiation, Nutritional requirements and types of media used in tissue culture
3. Micro-propagation; procedure, applications, problems and limitations: Morphogenesis, organogenesis and embryogenesis
4. Techniques of in vitro cultures- Meristem, In vitro pollination & fertilization, ovary and ovule culture and its significance in hybrid development
5. Anther and pollen culture for haploid production; Embryo culture, embryo rescue and its significance

6 & 7. Somatic Embryogenesis, synthetic seeds and their significance, somaclonal variation: types, molecular basis. applications and achievements
8 & 9. Introduction to various molecular markers: RFLP, RAPD, ISSR, AFLP, SSR, SCAR, CAPS, SNP etc.
10. Nucleic acid hybridization (Southern, Northern and Western), PCR and its applications,
11. Marker-assisted selection (MAS) for crop improvement, mapping QTL and mapping population in MAS.
12 & 13. Introduction to recombinant DNA technology: DNA modifying enzymes & vectors, Gene cloning and DNA / cDNA libraries.
14. Plant genetic transformation – physical (Gene gun method), chemical (PEG mediated) and *Agrobacterium*-mediated gene transfer methods,
15. Transgenics and its importance in crop improvement with success stories,
16. Public perception of biotechnology, social, ethical, legal and biosafety issues and regulatory mechanism related to genetically modified crops.

Practical

1 Visit to Plant Tissue Culture and Molecular Biology lab and good laboratory practices
2 & 3 Preparation of stock solutions of MS Medium
4. Preparation & sterilization techniques used in tissue culture
5. Micropropagation, Callus induction and culture,
6 & 7 Anther culture, Apical meristem culture,
8. Preparation of synthetic seeds,
9. Preparation of reagents for DNA extraction from plant tissue,
10. Isolation of genomic DNA,
11 & 12. Quantification of DNA; Agarose Gel Electrophoresis & visualization of DNA
13. Restriction digestion of Lambda DNA
14. PCR amplification of DNA
15. Gel electrophoresis of amplified DNA.
16. Visit to commercial plant tissue culture laboratory.

References:

- Introduction to plant tissue culture by M.K.Razdan, Science publishers, Inc.2019
- Biotechnology Expanding Horizons by B.D.Singh, Kalyani publishers. 2024

Course No.: FRMJ-3.1.1

Course Tile: Dry Land Horticulture-3(2+1)

Lecture Outline

Theory

1. Dry land horticulture definition, importance and limitation of dry land horticulture, present status constraints encounter in drylands and future scope.
2. Watershed development, soil and water conservation techniques and management of dry land horticulture crops.
3. Methods of control and impounding of catch pits in dry land horticulture run-off water, water farm ponds, trenches, contour bunds, macro pits in dry land horticulture.
4. In-situ water harvesting methods, micro catchment, different types of tree basins, use of shelter belts, anti-transpirants, growth regulators in dry land horticulture
5. Alternative land use systems- mulching- soil and moisture conservation methods- chemical applications in dryland horticulture
6. Management of nutrients, water, weeds and problem soils-organic amendments followed in dry land horticulture crops
7. Nutrient composition and uses-origin and distribution-species and cultivars- climate and soil requirements varieties -cropping systems and intercropping -varieties suitable for dry land system- spacing and planting patterns in for rainfed areas- in situ grafting and budding techniques followed in Ber
8. Mulching- soil and moisture conservation methods- Alternative land use systems training and pruning methods- physiology of flowering-regulation of cropping- top working and rejuvenation -use of plant growth regulators - post harvest handling-economics of production in ber.
9. Nutrient composition and uses-origin and distribution-species and cultivars- climate and soil requirements varieties -cropping systems and intercropping -varieties suitable for dry land system- spacing and planting patterns in for rainfed areas- followed in Pomegranate
10. Mulching- soil and moisture conservation methods- Alternative land use systems training and pruning methods- physiology of flowering-regulation of cropping- top working and rejuvenation -use of plant growth regulators - post harvest handling-economics of production in Pomegranate
11. Nutrient composition and uses-origin and distribution-species and cultivars- climate and soil requirements varieties -cropping systems and intercropping -varieties suitable for dry land system- spacing and planting patterns in for rainfed areas- in situ grafting and budding techniques followed in Custard apple
12. Mulching- soil and moisture conservation methods- Alternative land use systems training and pruning methods- physiology of flowering-regulation of cropping- top working and rejuvenation -use of plant growth regulators - post harvest handling-economics of production in Custard apple
13. Nutrient composition and uses-origin and distribution-species and cultivars- climate and soil requirements varieties -cropping systems and intercropping -varieties suitable for dry land system- spacing and planting patterns in for rainfed areas- in situ grafting and budding techniques followed in Aonla
14. Mulching- soil and moisture conservation methods- Alternative land use systems training and pruning methods- physiology of flowering-regulation of cropping- top working and rejuvenation -use of plant growth regulators - post harvest handling-economics of production in Aonla
15. Nutrient composition and uses-origin and distribution-species and cultivars- climate and soil requirements varieties -cropping systems and intercropping -varieties suitable for dry land system- spacing and planting patterns in for rainfed areas- in situ grafting and budding techniques followed in Fig
16. Mulching- soil and moisture conservation methods- Alternative land use systems training and pruning methods- physiology of flowering-regulation of cropping- top working and rejuvenation -use of plant growth regulators - post harvest handling-economics of production in Fig
17. Nutrient composition and uses-origin and distribution-species and cultivars- climate and soil requirements varieties -cropping systems and intercropping -varieties suitable for dry land system- spacing and planting patterns in for rainfed areas in Datepalm

18. Mulching- soil and moisture conservation methods- Alternative land use systems training and pruning methods- physiology of flowering-regulation of cropping - use of plant growth regulators - post harvest handling-economics of production in Datepalm.
19. Composition and uses-origin and distribution-species and cultivars- climate and soil requirements varieties -cropping systems and intercropping -varieties suitable for dry land system- spacing and planting patterns in for rainfed areas- in situ grafting and budding techniques followed in Jamun
20. Mulching- soil and moisture conservation methods- Alternative land use systems training and pruning methods- physiology of flowering-regulation of cropping- top working and rejuvenation -use of plant growth regulators - post harvest handling-economics of production in Jamun
21. Composition and uses-origin and distribution-species and cultivars- climate and soil requirements varieties -cropping systems and intercropping -varieties suitable for dry land system- spacing and planting patterns in for rainfed areas- in situ grafting and budding techniques followed in Phalsa
22. Mulching- soil and moisture conservation methods- Alternative land use systems training and pruning methods- physiology of flowering-regulation of cropping- top working and rejuvenation -use of plant growth regulators - post harvest handling-economics of production in Phalsa
23. Composition and uses-origin and distribution-species and cultivars- climate and soil requirements varieties -cropping systems and intercropping -varieties suitable for dry land system- spacing and planting patterns in for rainfed areas- in situ grafting and budding techniques followed in Karonda
24. Mulching- soil and moisture conservation methods- Alternative land use systems training and pruning methods- physiology of flowering-regulation of cropping- top working and rejuvenation -use of plant growth regulators - post harvest handling-economics of production in Karonda
25. Nutrient composition and uses-origin and distribution-species and cultivars- climate and soil requirements varieties -cropping systems and intercropping -varieties suitable for dry land system- spacing and planting patterns in for rainfed areas- in situ grafting and budding techniques Mulching- soil and moisture conservation methods- Alternative land use systems training and pruning methods- physiology of flowering-regulation of cropping- top working and rejuvenation -use of plant growth regulators - post harvest handling-economics of production in Wood apple
26. Nutrient composition and uses-origin and distribution-species and cultivars- climate and soil requirements varieties -cropping systems and intercropping -varieties suitable for dry land system- spacing and planting patterns in for rainfed areas- in situ grafting and budding techniques Mulching- soil and moisture conservation methods- Alternative land use systems training and pruning methods- physiology of flowering-regulation of cropping- top working and rejuvenation -use of plant growth regulators - post harvest handling-economics of production in bael.
27. Nutrient composition and uses-origin and distribution-species and cultivars- climate and soil requirements varieties -cropping systems and intercropping -varieties suitable for dry land system- spacing and planting patterns in for rainfed areas- techniques followed in Dragon fruit
28. Mulching- soil and moisture conservation methods- Alternative land use systems training and pruning methods- physiology of flowering-regulation of cropping- top working and rejuvenation -use of plant growth regulators - post harvest handling-economics of production in Dragon fruit
29. Composition and uses-origin and distribution-species and cultivars- climate and soil requirements varieties -cropping systems and intercropping -varieties suitable for dry land system- spacing and planting patterns in for rainfed areas- in situ grafting and budding techniques followed in Tamarind
30. Mulching- soil and moisture conservation methods- Alternative land use systems training and pruning methods- physiology of flowering-regulation of cropping- top working and

rejuvenation -use of plant growth regulators - post harvest handling-economics of production in Tamarind

31. Composition and uses-origin and distribution-species and cultivars- climate and soil requirements varieties -cropping systems and intercropping -varieties suitable for dry land system- spacing and planting patterns in for rainfed areas- in situ grafting and budding techniques Mulching- soil and moisture conservation methods- Alternative land use systems training and pruning methods- physiology of flowering-regulation of cropping- top working and rejuvenation -use of plant growth regulators - post harvest handling-economics of production in West Indian cherry
32. Composition and uses-origin and distribution-species and cultivars- climate and soil requirements varieties -cropping systems and intercropping -varieties suitable for dry land system- spacing and planting patterns in for rainfed areas- in situ grafting and budding techniques Mulching- soil and moisture conservation methods- Alternative land use systems training and pruning methods- physiology of flowering-regulation of cropping- top working and rejuvenation -use of plant growth regulators - post harvest handling-economics of production in Bilimbi

Practical

1. Study of rainfall pattern and distribution of rain in dry land area
2. Study of contour bunding/ Trenching and micro catchment areas in dry land horticulture
3. Study on soil erosion and its control
4. Study on moisture conservation methods followed in dry land horticulture
5. Special techniques of planting and after care in dry land horticulture
6. Water use efficiency- need based irrigation and micro system of irrigation
7. Description and identification of varieties study on morphological and anatomical features to sustain in dryland areas and canopy management in Ber
8. Description and identification of varieties study on morphological and anatomical features to sustain in dryland areas and canopy management in Pomegranate
9. Description and identification of varieties study on morphological and anatomical features to sustain in dryland areas and canopy management in Custard apple
10. Description and identification of varieties study on morphological and anatomical features to sustain in dryland areas and canopy management in Fig
11. Description and identification of varieties study on morphological and anatomical features to sustain in dryland areas and canopy management in Aonla, Bael
12. Description and identification of varieties study on morphological and anatomical features to sustain in dryland areas canopy management in Jamun, Phalsa
13. Description and identification of varieties study on morphological and anatomical features to sustain in dryland areas and canopy management in Dragon Fruit, Wood apple
14. Description and identification of varieties study on morphological and anatomical features to sustain in dryland areas canopy management in Datepalm, Bael, Carissa
15. Description and identification of varieties study on morphological and anatomical features to sustain in dryland areas and canopy management in Tamarind, West Indian cherry and Bilimbi
16. Visit to micro catchment and water shed area

References

- Chundawat, BS 1990. Arid Fruit Culture. Oxford and IBH, New Delhi
- PL Taroj, R.B. Vashishtha, D.G.Dhandar 2004. Advances in Arid Horticulture. Internal Besok Distributing Co., Lucknow
- T. Pradeep Kumar, B. Suma, Jyothi Bhaskar and KN Sathesan. 2008. Management of Horticultural Crops. New India Publishing Agency.

Course No.: PBMN 3.10.1

Course Title: Introductory Crop Physiology-2(1+1)

Lecture Outlines

Theory

1. Introduction-Definition of Plant and Crop Physiology- Importance of Crop Physiology in Horticulture.
2. Water relations in plants- Properties and functions of water in plant metabolism- Osmosis - diffusion – Diffusion pressure deficit. water uptake (passive and active) and transport -Water potential and its components.
3. Methods of measurement of water potential in plants - Mechanism of water Absorption- Ascent of Sap- Soil Plant Atmospheric Continuum (SPAC).
4. Transpiration- definition and its significance, types of transpiration- Structure, distribution and classification of stomata- Root pressure – Guttation - Stem bleeding.
5. Factors affecting transpiration-Antitranspirants - Mechanism of opening and closing of stomata.
6. Types of Abiotic stresses – Levitt's Classification of plants based on stress response- Drought/ water logging stress: Effect of water stress on plant growth and development-mechanism of water stress tolerance in plants.
7. Effect of high/low temperature stress on plant growth and development-mechanism of temperature stress tolerance in plants.
8. Effect of light (High/Low) stress on plant growth and development-mechanism of light stress tolerance in plants
9. Plant Nutrition: Criteria for essentiality of nutrients- Classification of nutrients based on uptake and biochemical function- Mechanism of absorption of plant nutrients.
10. Physiological functions of macro, micro and beneficial nutrients - Biological Nitrogen fixation in plants.
11. Deficiency and toxicity symptoms of nutrients – Amelioration
12. Photosynthesis: Definition, Importance-Structure and functions of chloroplast- Light reactions- Electron transport system of Cyclic, Non-cyclic (Z-scheme), Pseudo cyclic photophosphorylation
13. Photosynthesis: Dark reactions of C3, C4 and CAM pathways - significance and differences.
14. Photorespiration: Definition and its significance- C_2 cycle- Factors affecting photosynthesis- light, CO2, temperature and water- Methods of measurement of photosynthesis.
15. Herbicides: Definition- classification of herbicides- Mode of action of herbicides.
16. Secondary metabolites- their role in plant defence.

Practical

1. Preparation of solutions
2. Measurement of water potential in plants
3. Measurement of Relative Water Content (RWC) in plants
4. Measurement of root pressure in seedlings
5. Identification of structure, distribution, opening and closing of stomata
6. Measurement of Transpiration rate
7. Estimation of chlorophyll content in leaves
8. Separation and Identification of plant pigments in horticultural crops
9. Measurement of photosynthesis by hill reaction
10. Effect of water stress on plant growth and development
11. Effect of light stress on plant growth and development
12. Effect of salinity stress on plant growth and development
13. Effect of temperature stress on plant growth and development
14. Identification of macro and micronutrient deficiency and toxicity symptoms in horticultural crops
15. Identification of various tropic and nostic movements in plants
16. Rapid tissue tests

References:

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- Richard, N. Arteca. 2004. *Plant Growth Substances. CBS. New Delhi.*
- Jacobs, W. P. *1979. Plant Hormones And Plant Development. Cambridge Univ. London.*
- Basra, A. S. *2004. Plant Growth Regulators in Agriculture & Horticulture. HAWARTH*
- *press. New York.*
- Lincoln Taiz and Eduards Zeiger (5th Edition). *Plant physiology*
- Noggle G.R and Fritz T.G. *Introductory Plant Physiology*
- Pandey and Sinha. *Plant Physiology*
- Salisbury and Ross. *Plant Physiology*
- Carl fedtke. *Biochemistry and Physiology of Herbicide Action*
- Aswani pareek, S.K. Sopory, Hans Bohnert Govindjee. *Abiotic stress adaptation in plants Physiological, Molecular and Genomic foundation Horst Marschner, Mineral Nutrition of Higher plants*

Course No.:ASMJ-3.9.1

Course Title: Horticulture Based Integrated Farming System-2 (1+1)

Lecture Outline

Theory

1. Farming System-Introduction, scope, importance, concept, principles and objectives of farming system. Factors affecting types of farming system
2. &3.Classification of farming systems: based on climate, stage of development, components, mode of ownership, profitability, irrigation and degree of mechanisation – Factors affecting types of farming system
4. Farming system components and their maintenance
5. Evolution and diversity of farming systems in India from stone age survival to swidden farming, Nomadic pastoralism and agro-pastoralism in warm and cold deserts of India
6. Horticulture crop based livestock farming, subsistent livelihoods in rain-fed areas of India
7. &8. Industrial and semi-industrial agriculture- agro-enterprises, agribusiness systems. Agribusiness systems for marketing grains, vegetables, fruits, flowers, fibre crops, medicinal and aromatic plants – Value addition for income enhancement
9. Integrated farming system- objectives, characteristics, advantages and disadvantages, components in IFS, elements of IFS
10. Site specific development of IFS model for different agro climatic zones of India and AP
11. Resource use efficiency and optimization of resource use by different methods
12. Resource cycling and flow of energy in different farming systems
13. Sustainable livelihood agriculture- problems and its impact on horticulture.
14. Indicators of soil health and environment for horticulture based IFS
15. Site specific horticulture- based IFS models: Horticulture and vegetable intercropping systems, high density plantation, bankable IFS models and rooftop farming
16. Farm typology

Practical

1. Preparation of horticulture based cropping scheme and integrated farming system models for irrigated condition
2. Preparation of horticulture based cropping scheme and integrated farming system models for rainfed condition

3. Preparation of horticulture based cropping scheme and integrated farming system models for dryland condition
4. Preparation of enriched farmyard manure
5. Preparation of vermicompost
6. Visit to urban waste recycling unit and model farmers' field
7. Preparation of farm layout plans
8. Estimating horticulture crop yields
9. Energy budgeting in different horticulture crops
10. Estimation of EC/pH/TDS of water
11. Estimation of TDS of water
12. C sequestration, budgeting, footprints.
13. Organic fertigation in orchards; use of biorationales.
14. Working out ecological optimum zones.
15. Project making exercises for establishment of horticulture based production models under different situation
16. Visit of IFS model in nearby institutes and farmers' fields

References:

- Farming System and sustainable agriculture, S.R. Reddy, Kalyani publishers
- Integrated Farming Systems, H. M. Jayadeva and B. K. Ramachandrappa

Course No.: PBMN-3.10.2
Course title: General Microbiology-3 (2+1)

Lecture Outline

Theory

1. **Evolution of microorganism;** Origin of Universe-Nebular Hypothesis; Planetesimal Hypothesis; Tidal Hypothesis; Recent Hypothesis; The Primitive Atmosphere of Earth; Chemical Origin of Life (Chemogeny); Biological Evolution of Biogeny; Cognogeny.
2. Introduction and Milestones in microbiology -Discovery Era-Antony Van Leeuvenhoek; Transition Period-F. Redi, Needham, Spallanzani; Golden Age of Microbiology (1854-1914)-Louis Pasteur, Tyndall, L.J. Lister, Winogrdasky, Robert Koch, Hesse, Jenner, Metchnikoff, Roux, Paul Ehrlich, Domagk, Fleming;
3. Era of Molecular Biology - Beadle & Tatum, Delbruck & Luria, Joshwa Lederberg and Esther Lederberg, Avery, MacLeod and McCarty, Griffith, Tatum and Lederberg, Zinder and Lederberg, – Nobel Laureates in Microbiology.
4. Germ theory of disease – contribution of Hippocrates, Louis Pasteur and Robert Koch
5. Pure culture methods by Joseph Lister, Beijerinck, Winogradsky, Schroder and Von Dush, John Tyndall *etc*.,

6. Taxonomy of microorganism (phenotypic and phylogenic). - classification, nomenclature, and identification. Hierarchial Arrangement in Taxonomy; Haeckel's Three–Kingdom Concept, Whittaker's Five-Kingdom Concept, Three-domain Concept of Carl Woese; Phylogenetic Tree, Different microbial groups - Characters and economic importance – Archaea, Bacteria, Fungi, Protozoa and Algae. Major differential features between Archaea, bacteria and Eukarya;
7. Morphology and fine structure of bacteria; Structure and function of bacterial cell wall, internal structures and surface structures,
8. Reproduction in bacteria (Binary fission, Budding, Cyst, Conidia, Endospores)
9. Types of culture media, synthetic and non synthetic, Liquid and solid media, pure culture techniques and preservation of cultures.
10. Specimen preparation - fixation, dyes and simple staining and differential staining.
11. Growth of microorganisms – cell division – growth cycle of bacteria (lag phase, log phase, stationery and death phase) – generation time – growth rate – growth yield.
12. Measurement of bacterial growth, Factors Influencing bacterial growth
13. Protection against infections -Sterilization methods-physical methods.
14. Protection against infections -Sterilization methods- chemical methods.
15. Microscopy- Historical developments, parts, principles of microscopy, resolving power and numerical aperture, Simple, Compound, bright field microscope,
16. Microscopy- dark field microscope, phase contrast microscope, Fluorescence Microscope, Differential Interference Contrast (DIC) Microscope, Transmission and scanning electron microscope.
17. General characters of viruses and brief description of bacteriophages- structure of viruses and phages (bacterial viruses) – structure of T_4 phage – different morphological types of phages
18. Lytic and lysogenic cycle (virulent and temperate phages with examples) – viroids and prions.
19. Microbial associations (intra microbial and extra microbial association) –Beneficial and harmful associations - symbiosis, antibiosis, mutulism, parasitism, synergism etc.
20. Microbial metabolism -enzymes and classification, Factors influencing enzyme activity
21. Carbohydrate catabolism (Glycolysis, Krebs cycle and Electron transport chain)
22. Nutritional groups of bacteria (autotrophs, heterotrophs, phototrophs and chemotrophs) and examples under each category
23. Microbial genetics–Genome, gene, genome organisation, phenotype, genotype–Replication.
24. Microbial genetics - Transcription - Translation – Genetic code.
25. Lac operon in *E. coli* – induction and repression, negative and positive regulation of Lac operon
26. Types of mutations – spontaneous and induced mutations (substitution addition and deletion – mutations leading to nonsense, missense, neutral and frameshift mutations)
27. Genetic recombination by transformation in *Pneumococcus* – genetic recombination by conjugation in *E. coli*, sex factor, F^+ x F^- cross, Hfr x F^- crosses
28. Genetic recombination by transduction in *Salmonella* – generalized transduction and specialized transduction

29. Genetic engineering- plasmids, types of plasmids and episomes and genetically modified organisms, Transposable elements
30. Food microbiology – microbial spoilage–principles of food preservation
31. Preservation methods – Thermal preservation (Blanching, Pasteurization, Sterilization, Canning, Extrusion Cooking Baking, Roasting, Grilling Dehydration, Concentration, Evaporation, Intermediate Moisture), low temperatures (Refrigeration, Freezing, Lyophilisation, Cryogenic Freezing, Dehydrofreezing, Freeze Concentration)
32. Composting, General compost properties, Biodegradation – definition – composition of biogas – microbiology of biogas production.

Practical

1. General laboratory- principles and biosafety.
2. Familiarization with instruments, equipment, glassware *etc*.
3. Introductionto microscopy.
4. Methods of sterilisation and disinfection.
5. Culture methods and evaluation of aseptic techniques with nutrient broth tubes and nutrient agar plates.
6. Isolation ofbacteria from soil (serial dilution method).
7. Isolation of fungi from soil.
8. Pure culture techniques (streak plate/pour plate/spread plate).
9. Maintenance and Preservation of microbial cultures.
10. Micrometry -Determination of size of micro-organisms (ocular and stage micrometer).
11. Staining methods (Simple staining and Gram's staining) and numeration of bacteria by stained slide method.
12. Estimation of microbial growth by Turbidimetry.
13. Identification of bacterial cultures (Morphological, cultural and biochemical methods).
14. Visit to vermicompost unit.
15. Visit to Biofertilizer unit.
16. Visit to biogas production unit.

REFERENCES

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- Agricultural Microbiology. - Rangaswami, G. and Bhagyaraj, D.J. 2001.Prentice Hall of India Pvt. Ltd., New Delhi
- General Microbiology.- Sullia, S.B. and Shantaram, S. 1998 Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi
- General Microbiology -Stainer,R-1987,Palgrave Macmillan

- Microbiology- R. P Singh-2007 Kalyani publication
- Introductory Microbiology- Heritage, J., Evans,E.G.V,Killington,R.A-2008 Cambridge University Press
- Introduction to Microbiology- Edward Alchano-2002 Jones and Bartlett hearing
- Introductory Microbiology - D. Balachandar R. Thamizh Vendan

Course No.: ASMN-3.9.1

Course Title: Introductory Agro forestry-2(1 + 1)

Lecture Outline

Theory

1. Agro-forestry: Definition and scope of Agroforestry system, Type of Agroforestry system, potential of Agroforestry in India, Prevailing agroforestry system in Andhra Pradesh.
2. MPTS- definition, role of MPTS in agroforestry system, its selection for different agroforestry system
3. &4. Ecological aspects of Agroforestry system, tree -crop interaction – above and below ground interactions for light water and nutrients
5. Nutrient recycling in Agroforestry system
6. Traditional Agroforestry as a viable choice to conserve Agro biodiversity in India. Shifting cultivation- taungya system
7. Classification of Agro-forestry systems based on arrangement and components
8. Role of agroforestry in soil and water conservation, windbreaks, shelterbelts–definition, objectives
9. Socio- economic aspects of Agroforestry system
10. Planning of Agroforestry- constraints- Design and Diagnostic study of agro-forestry system
11. &12 Silviculture: Definition and scope of silviculture system. Propagation of tree species, Regeneration by seed, coppice, root suckers, Transplanting, stump, branch cutting, rhizomes
13. &14 Nursery bed preparation and management, Cultural practices for bare root and seedling, field handling of nursery stock
15. Management of tree species – training - pruning - lopping, pollarding, coppicing
16. Silviculture of important tree species – choice of species- site factors, root, crown and bole characteristics, phenology,nutritional and water requirement, ground operation, tending, harvesting utility etc.

Practical

1. Identification of tree species and seeds
2. Measurement of tree height and diameter
3. Measurement of tree volume
4. Plant propagation methods
5. Seed treatment and seed viability tests
6. Preparation of nursery bed
7. Afforestation methods
8. &9. Practice of training, pruning, coppicing, pollarding etc.
10. &11. Natural and artificial regeneration

12. Design and diagnostic survey of agro-forestry system
13. Evaluation of agro-forestry system in different agro climatic zones
14. Exposure visit to prevailing agroforestry systems
15. Visit to nearby forest nurseries
16. Visit to social forest nursery

References:

- Nair, P.K.R : 1993.An Introduction to Agroforestry, Kluar Academic Publisher

Course No.: ENMJ - 3.6.1

Course Title: PESTS OF FIELD CROPS AND THEIR MANAGEMENT-2(1+1)

Lecture Outline

Theory

1. &2. Rice & Wheat: Yellow Stem Borer, Gallmidge, Brown Planthopper, Green Leafhopper, Hispa, Leaf Folder, Ear Head Bug, Grasshoppers, Root Weevil, Swarming Caterpillar, Climbing Cutworm, Case Worm, Whorl Maggot, Leaf Mite, Panicle Mite. IPM Practices in Rice; Wheat: Ghujia Weevil, Ragi Pink Borer, Termites.
3. &4 Sorghum and other Millets: Sorghum Shoot Fly, Stem Borer, Ragi Pink Borer, Sorghum Midge, Ear Head Bug, Red Hairy Caterpillar, Aphids, Maize Shoot Bug, Flea Beetle, Blister Beetles, Ragi Cutworm, Ragi Root Aphid, Fall Army Worm, Rugose spiralling whitefly.
5. Sugarcane: Early Shoot Borer, Internodal Borer, Top Shoot Borer, Scales, Leafhoppers, White Grub, Mealy Bugs, Termites, Whiteflies, Woolly Aphid, Yellow Mite.
6. &7 Cotton: Spotted Bollworm, American Bollworm, Pink Bollworm, Tobacco Caterpillar, Leafhopper, Whiteflies, Aphid, Mites, Red Cotton Bug, Dusky Cotton Bug, Leaf Roller, Stem Weevil, Grasshoppers, Mealybug, IPM In Cotton.
8. 8 Jute & Mesta: Jute Semilooper, Jute Stem Weevil, Jute Stem Girdler, Bihar Hairy Caterpillar. Mesta: Hairy Caterpillars, Stem Weevil, Mealy Bugs, Leafhopper, Aphid.
9. 9 Sunhemp: Hairy Caterpillars, Stem Borer, Flea Beetle; Tobacco: Tobacco Caterpillar, Aphid, Whitefly, Stem Borer.
10. &11Pulses: Gram Caterpillar, whitefly, Plume Moth, Pod Fly, Stem Fly, Spotted Pod Borer, Cowpea Aphid, Cow Bug, Pod Bug, Leafhopper, Stink Bug, Blue Butterflies, Redgram Mite, Leaf Miner.
12. Ground Nut: White Grub, Leaf Miner, Red Hairy Caterpillar, Tobacco Caterpillar, Leafhopper, Thrips, Aphid, Pod Bug, Jewel Beetle, Jassids.
13. Soyabean: Stem Fly, Ragi Cutworm, Leaf Miner, Whitefly. Castor: Semilooper, Shoot and Capsule Borer, Tobacco Caterpillar, Castor Slug.
14. Sesamum: Leaf and Pod Borer, Gall Fly, Sphinx Caterpillar; Safflower: Aphids, Leaf Eating Caterpillars.
15. Mustard: Aphid, Saw Fly, Diamond Back Moth, Painted Bug. Sunflower: Helicoverpa sp. and Spodoptera sp., Leafhopper, Bihar Hairy Caterpillar, Thrips.
16. Rodents & Birds: Rodents damaging crops in field and stores, key for identification of rodents, management of rodents in field and storage, coconut rodents and their management. Birds: Various birds infesting crops and their management.

Practical

1. Identification of insect pests of rice and their damage symptoms
2. Identification of insect pests of wheat and their damage symptoms
3. Identification of insect pests of Sorghum and other Millets and their damage symptoms
4. Identification of insect pests of Sugarcane and their damage symptoms
5. Identification of insect pests of Cotton and their damage symptoms
6. Identification of insect pests of Pulses and their damage symptoms
7. Identification of insect pests of Groundnut and their damage symptoms

8. Identification of insect pests of Jute and Mesta and their damage symptoms
9. Identification of insect pests of Sun hemp and their damage symptoms
10. Identification of insect pests of Tobacco and their damage symptoms
11. Identification of insect pests of Soyabean and their damage symptoms
12. Identification of insect pests of Castor and their damage symptoms
13. Identification of insect pests of Sesamum and safflower and their damage symptoms
14. Identification of insect pests of Mustard and their damage symptoms
15. Identification of insect pests of Sunflower and their damage symptoms
16. Identification of non-insect pests and damage symptoms of pests of Rodents & Birds etc. and their damage symptoms

References:

- Vasantharaj David, B. 2003. Elements of Economic Entomology. Popular Book Depot,Coimbatore.
- Vasantharaj David, B and Aanathakrishnan, T.N.. 2006. General and Applied Entomology. McGraw-Hill Publishing House, New Delhi.
- Dennis S Hill 1987 Agricultural Insect Pests of tropics and their control, Cambridge
- Universtiy Press, New York
- Khare, S.P. 1993. Stored Grain Pests and Their Management. Kalyani Publishers, Ludhiana.
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- Ramakrishna Ayyar, T.V. 1963. Handbook of Economic Entomology for South India. Government Press, Madras.

Course No.: ESMN - 3.11.1

Course Tile: Basic Statistics and Experimental Designs-3 (2+1)

Lecture Outline

Theory

1. Introduction to statistics, Limitations of statistics, Definition of variable, types and sources of data, classification and tabulation of data.
2. Construction of Frequency Distribution and graphical representation of data: histogram, frequency polygon and frequency curve, cumulative frequency curve (Ogive)
3. Diagrammatic representation of data: simple, multiple components and percentage bar diagrams, pie diagram.
4. Measures of Central tendency – Arithmetic Mean (A.M) for Grouped and Ungrouped data, Merits and Demerits of A.M.
5. Measures of Central Tendency –Median and mode for Grouped and Ungrouped data, Merits and Demerits of Median and Mode.
6. Measures of Central Tendency –Geometric Mean and Harmonic Mean for Grouped and Ungrouped data, its Merits and Demerits, Characteristics of a Satisfactory Average.
7. Measures of Dispersion – Range, Quartile Deviation (Q.D) for Grouped and Ungrouped data.
8. Measures of Dispersion – Mean Deviation (M.D), Standard Deviation (S.D) for Grouped and Ungrouped data
9. Measures of Dispersion – Variance, Coefficient of Variation (C.V) for Grouped and Ungrouped data. Skewness and kurtosis for Grouped and Ungrouped data
10. Definition of Probability, Basic concepts of Probability(event, favourable events, Exhaustive events, equally likely events and mutual exclusive events)
11. Addition law for two variables
12. Multiplication law for two variables
13. Concept of Normal distribution and its limitations

14. Properties of Normal distribution
15. Introduction for sampling and basic concepts
16. Sampling techniques: Simple random sampling (Lottery method, Random table method)
17. Introduction and Basic concepts of Testing of Hypothesis
18. Steps involved in Testing of Hypothesis
19. SND (Z) test for One Sample
    SND (Z) test for Two Samples (Equality of Means)
20. Students' t-test for One Sample
21. Students' t-test for Two Samples (Equality of Means)
22. Paired t-test and F- test
23. Chi square test for 2x2 Contingency Table
24. Chi-square test for goodness of fit of Mendalian ratios
25. Correlation – Definition, Scatter Diagram, Positive and Negative Correlations
26. Correlation – Properties, Calculation of Coefficient of Correlation and its testing
27. Concept of Regression, Fitting of linear regression lines
28. Concept of regression coefficients, properties and testing of regression coefficients
29. Introduction to Experimental Designs – Basic Principles of Experimental Designs and Analysis of Variance (ANOVA) and its assumptions
30. Completely Randomized Design – Layout and Analysis
31. Randomized Block Design – Layout and Analysis
32. Latin Square Design – Layout and Analysis

Practical

1. Construction of frequency distribution table
2. Arithmetic Mean (A.M) for Grouped and Ungrouped data
3. Median and Mode for Grouped and Ungrouped data
4. Geometric Mean and Harmonic Mean for Grouped and Ungrouped data
5. Quartile Deviation & Mean Deviation for Grouped and Ungrouped data
6. Standard Deviation and Coefficient of variation for Grouped and Ungrouped data
7. Skewness and Kurtosis for ungrouped data and grouped data
8. Normal distribution
9. SND (Z) test for One Sample and Two Samples (Equality of Means)
10. Students' t-test for One Sample, Two Samples and Paired t-test (Equality of Means)
11. F- test, Chi square test for 2x2 Contingency Table and chi-square test for goodness of fit of Mendalian ratios
12. Calculation of Coefficient of Correlation and its testing
13. Fitting of linear regression lines and testing of regression coefficients
14. Analysis of CRD
15. Analysis of RBD
16. Analysis of LSD

References:

- Nageswara Rao, G 2007. Statistics for Agricultural Sciences. B S Publications, Hyderabad
- Rangaswamy, R 1995. A Text Book of Agricultural Statistics. New Age International (P) Limited, Hyderabad.
- Chandel SRS, Hand Book of Agricultural Statistics. Achal Prakashan Mandir publications, New Delhi.
- Agrawal, B .L. Programmed Statistics. 2nd Edition, New Age International Publishers, Hyderabad

Course No.: VLAE-3.0.1
Course Title: Veterinary Livestock Production and Management-1(0+1) NG
Lecture Outline

Practical

1. (A) Taxonomical Classification, Domestication and ethology of farm animals.
   (B) Land-Live stock Crop human relationship.
   (C) Body parts of domestic animals.
2. (A) Role of livestock in rural livelihood.
   (B) Livestock dynamics.
3. (A) Various breeds of cattle, buffalo, sheep, goat, swine and poultry
   (B) Breeding methods and its importance.
4. Classification of feed stuffs and their nutritive values, Ration formulation and forage Production, silage making, Hay making.
5. Feeding practices of dairy animals, sheep and goat and their digestive physiology.
6. Reproductive anatomy and physiology of dairy cattle.
7. Reproductive behaviors of dairy animals.
8. Assisted reproductive technologies in dairy cattle.
9. (A) Health care management of farm animals.
   (B) Animal diseases and its prevention and control.
10. Importance of vaccination and deworming in farm animals and their schedules.
11. Housing management of farm animals and climate resilient technologies.
12. Routine of farm operation and record keeping.
13. Visit to dairy farm, Sheep and Goat farm.
14. Visit to piggery and poultry farm.
15. Livestock economics and entrepreneurship.
16. Livestock and livestock products and marketing channels.

References

- Livestock Production Management -Sastry N.S.R. and Thomas C.K. (2005) 4th Ed.Kalyani Publishers
- Goat, Sheep and Pig Production Management – Jagadish Prasad (2005) 3rd Ed. Kalyani publishers
- Poultry production (Reprinted 2011) – R.A.Singh (1990) 3rd Ed. Kalyani Publishers

Course No.: NG 3.0.1
Course Title: Educational Tour-2(0+2) NG

In case any student absents from educational tour, for reasons beyond his/her control, “Not attended” will be furnished under attendance, “Incomplete” will be recorded in remarks. Such students shall reregister the course in the immediate next semester and perform the tour at their own expenditure, duly submitting record of their tour as per the route plan of their batch with signatures of respective destination station heads. If the student has successfully performed the course, “Satisfactory” will be furnished under remarks column.

LECTURE OUTLINES FOR IV SEMESTER COURSES

Course No.: PHMJ - 3.5.1

Course Tile: Processing and Value Addition of Horticultural Crops-3 (2+1)

Lecture Outline

Theory

1. History of Food Preservation in India -Importance and Scope of Fruit and Vegetable Preservation in India
2. Food Pipeline- Losses in Post harvest System

3. & 4. Principles and Method of Preservation- Preservation by Asepsis, High Temperature, Low temperature, Chemicals, Drying, Filtration, Carbonation, Sugar, Salt, Fermentation, Acids, Oil and spices, Antibiotics and Irradiation
5. Unit Operations in Food Processing
6. Principles and Guidelines for the establishment of processing units
7. & 8.Canning and bottling of fruit and Vegetables
9. Spoilage of Canned foods
    a. Spoilage due to physical and chemical changes
    b. Microbial spoilage
    c. Discoloration of fruit and canned products
10. & 11.Unfermented Fruit Beverages- Preparation and Preservation of unfermented fruit beverages juices-Methods of fruit juice extraction- Preparation of Juice, RTS, Nectar, cordial, Squash, Syrup, Fruit juice concentrate, Crush, Fruit juice powders, Barley water
12. Fermented Fruit beverages- Types of wines
13. & 14.Preservation by using Sugar-Jams, Jellies, Marmalades, Preserves, Candies Crystallized and Glazed fruits
15. Drying and dehydration of Fruits and Vegetables- Different methods of drying - Types of driers
16. Food Concentration –Methods of concentration –Changes during concentration –Intermediate Moisture Foods
17. Preservation with Salt and Vinegar- Pickles, Chutneys and Sauces
18. Tomato Processing
19. Mushroom Processing
20. Potato Processing
21. Freezing of Fruits and Vegetables-Methods of freezing- Sharp freezing, Quick freezing, Cryogenic freezing, dehydro freezing, freeze drying-Changes during freezing
22. Spoilage in processed foods, quality control of processed products
23. Technology for fresh cut fruit and vegetables-Minimal processing, cold plasma, edible coatings, bioactive compounds as additives to extend shelf life.
24. Packaging techniques for processed food…glass, metal, plastic (Collapsible laminated, coextruded) containers
25. & 26.Processing of plantation crops….Coconut, oil palm, cashew nut, Areca Nut, Cocoa
27. & 28.Utilization of Fruit and Vegetable waste- Development of value-added products from waste
29. & 30.Government policy on import and export of processed foods (EXIM Policy)
31. Food laws Statutory provisions of quality control of India
32. Food Standardization and Regulatory agencies in India(FSSAI)

Practical

1. Equipment used in food processing units
2. Bottling of fruits and vegetables
3. Determination of TSS in fruits and vegetables
4. Preparation of syrup and brine
5. Preparation of unfermented fruit beverages RTS, Squash ,Syrup etc
6. Preparation of jams, jellies, marmalade
7. Preparation of preserves and candies
8. Pickling of Fruits and Vegetables
9. Preparation of chutneys and sauces
10. Dehydration of fruits and vegetables
11. Processing of plantation crops and value added products
12. Preparation of tomato products-Tomato Puree, Juice,Ketchup,Sauce etc
13. Freezing of fruits and vegetables
14. Cut out analysis of processed foods
15. Sensory evaluation of processed products
16. Visit to food processing units

References

- M. K. Kureel 2020. Postharvest Management and Value Addition of Fruits and Vegetables, Bio-Green Books.
- Srivastava R P, Sanjeev K 2019. Fruit and Vegetable Preservation – Principles and Practices, CBS Publishers and Distributors Pvt Ltd.
- Girdhari Lal, Siddappa G S, Tandon G. L 1967. Preservation of Fruits and Vegetables Indian Council of Agricultural Research, New Delhi.
- Norman N P, Food Science 2013. Springer Science & Business Media. Fellows P J. 2005. Food Processing Technology: Principles and Practice CRC Press, Wood head Publishing Ltd

Course No.: PBMJ-3.10.2

Course Title: Laboratory Techniques for Horticultural Crops-2(0+2)

Lecture Outline

Practical

1. Safety measures and maintenance of the laboratory
2. Study of laboratory equipment used for quality analysis of fruits and vegetables
3. Preparation of different standard solutions
4. Sampling procedures for quantitative analysis of Fruits and vegetables
5. Determination of physiological loss in weight (PLW) of fruits and vegetables
6. Determination of specific gravity in fruits and vegetables
7. Determination of fruit size, shape and juice content
8. Determination of fruit colour and firmness
9. Assessment of textural properties of harvested produce
10. Determination of total soluble solids (TSS) by hand refractometer and digital refractometer
11. Determination of pH
12. Determination of titrable acidity
13. Estimation of reducing sugars in fruits and vegetables by Lane Eynon Method
14. Estimation of total sugars and nonreducing in fruits and vegetables
15. Determination of Total antioxidants by DPPH free radical scavenging activity
16. Determination of Starch index (SI)
17. & 18 Estimation of ascorbic acid content in fruits and vegetables
18. & 20 Estimation of chlorophyll content
21. &22 Estimation of anthocyanin content in fruits and vegetables
23. &24 Estimation of carotenoid content in fruits and vegetables
25. &26 Estimation of phenolics in fruits and vegetables
27. &28 Sample preparation and digestion for leaf nutrient analysis
29. Estimation of nitrogen by Kjeldahl method
30. Estimation of Potassium using Flame Photometer
31. Estimation of Phosphorus using spectrophotometer
32. Estimation of micronutrients in plant leaves by atomic absorption spectrometry

REFERENCES

- AOAC International 2003. Official Methods of Analysis of AOAC International. 17th edn. Gaithersburg MD USA Association of Analytical Communities USA.
- Rangana S 2001. Handbook of Analysis and Quality control for fruits and vegetable products.2nd edn. Tata McGraw Hill. New Delhi.
- Linskens H F and Jackson J F 1995. Fruit Analysis Springer.
- Leo M L 2004. Handbook of Food Analysis 2nd edn. Vols I-III USA.
- Sarkar A K and Mahapatra 2015. Plant nutrient disorders diagnosis and management. New India Publishing Agency. New Delhi, India.

Course No.: PBMN-3.10.3

Course Title: Principles of Biochemistry-2(1+1)

Lecture Outline

Theory

1. Introduction to Biochemistry, water, pH and buffers
2. Cellular constituents structure and function and acid-base balance
3. Carbohydrates: Classification and structure
4. Amino acids: Classification and structure, essential amino acids
5. Proteins : Classification and functions
6. Lipids: Classification, Fatty acids – saturated, unsaturated and essential; Triglycerides
7. Vitamins :water soluble and fat soluble
8. Enzymes: function, properties and classification
9. Carbohydrate metabolism: Glycolysis, and glycogenolysis
10. TCA cycle, Electron transport chain, Bioenergetics of glucose
11. Lipids Metabolism - β-oxidation energetics and fatty acid biosynthesis
12. Amino acid metabolism –General reactions of nitrogen assimilations and excretion
13. Nucleic acids - Structure and functions of DNA and RNA
14. DNA Replication – Molecular process and enzymes involved; Genetic code
15. Transcription and Translation – Molecular process, post transcriptional modifications
16. Regulation of gene expression-Lac operon

Practical

1. Preparation of buffers and pH determination
2. Preparation of colloids
3. Qualitative tests of carbohydrates
4. Qualitative Tests of Lipids
5. Qualitative test for proteins
6. Quantitative Tests of Lipids
7. Quantitative test of proteins
8. Tests of enzyme action- potato oxidase, urease, and salivery amylase
9. Paper chromatography of amino acids
10. Paper chromatography of carbohydrates ascending and descending
11. Determination of starch
12. Determination of moisture content
13. Determination of crude protein
14. Determination of crude fat
15. Determination of crude fiber

References

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

Course No. ASMJ 3.9.2.
Course Title: Soil fertility and Nutrient Management-3 (2+1)
Lecture Outline

Theory

1. Introduction: Importance of soil fertility in crop production. Concepts of soil fertility and soil productivity. Definitions and differences. Soil as a source of plant nutrients
2. Nutrient Elements: Arnon's criteria of essentiality – Essential, Functional and Beneficial elements. Scientists responsible for the essentiality of individual nutrient elements.

3. Classification of essential nutrients. Ionic forms of plant nutrients in soil.
4. Nitrogen: Occurrence, content and distribution. Factors influencing the content of nitrogen in soil.Forms of soil nitrogen. Nitrogen Cycle – Transformations in soils – Mineralization (Aminisation and Ammonification) – Fate of released ammonia –
5. Factors affecting ammonium fixation. Nitrification – factors affecting nitrification – Fate of nitrate nitrogen – Denitrification – Nitrification inhibitors. Immobilization.
6. Nitrogen fixation: Different types – Biological fixation of nitrogen – Symbiotic and non-symbiotic – Nitrogen balance sheet – Gains and loses – Functions – Deficiency and toxicity symptoms – Corrective measures
7. Phosphorus: P – cycle – contents in soils – forms of phosphorus in soil – Inorganic and organic phosphorus compounds – Phosphorus fixation – Mechanisms of phosphate fixation.
8. Factors affecting phosphate fixation in soil – Methods to reduce phosphate fixation. (Organic matter additions, placement of P fertilizers etc.) – Quantity and intensity parameters – Functions – Deficiency and toxicity symptoms – Corrective measures
9. Potassium: content in soil – Source – forms of soil potassium – Potassium fixation. Factors affecting potassium fixation- Quantity and intensity parameters – Luxury consumption – Functions and deficiency symptoms – corrective measures.
10. Calcium – sources and content – forms of calcium in soil, factors affecting the availability of calcium in soil – Functions – Deficiency symptoms – Corrective measures.
11. Magnesium – Sources – Content – Forms of magnesium in soils. Factors affecting availability of magnesium. Functions – Deficiency symptoms – Corrective measures
12. Sulphur: S – Cycle – Occurrence – Forms of Sulphur in soil. Sulphur transformation in soils – Mineralization and immobilization. Sulphur Oxidation – Factors affecting oxidation in soils. Sulphide injury – Causes, symptoms and remedial measures – Functions – Deficiency symptoms and corrective measures
13. Micronutrient: Sources – forms in soil solution – Pools of micronutrients – Predisposing factors for occurrence of micronutrient deficiencies in soil and plants.
14. Zinc: Contents – Forms in soils- Critical limits in soils and plants, factors affecting availability of zinc – Functions – Deficiency and toxicity symptoms – Corrective measures
15. Copper – Content – Forms in soils – Critical limits in soils and plants. Factors affecting its availability – Functions – Deficiency and toxicity symptoms – Corrective measures
16. Iron – Content – Forms in soils – Critical limits in soils and plants. Factors affecting its availability – Functions – Deficiency and toxicity symptoms – Corrective measures
17. Manganese: Content – Forms in soils – Critical limits in soils and plants. Factors affecting its availability - Functions – Deficiency and toxicity symptoms – Corrective measures
18. Boron: Content – forms in soil – Critical limits in soils and plants. Factors affecting its availability – Functions – Deficiency and toxicity symptoms – Corrective measures
19. Molybdenum and chlorine – Content – Forms in soils – Critical limits in soils and plants. Factors affecting their availability – Functions – Deficiency and toxicity symptoms – Corrective measures
20. Soil fertility Evaluation: Approaches – Nutrient deficiency symptoms. Soil testing – Objectives of soil testing – Chemical methods for estimating available nutrients
21. Plant analysis- total and rapid tissue tests- critical levels of nutrients in plants
22. DRIS method-establishment of norms, advantages and disadvantages
23. Deficiency symptoms-indicator plants. Biological method of soil fertility evaluation.

24. Soil test based fertilizers recommendation: Critical nutrient concept (Cate and Nelson) – Critical levels of nutrients in soils.
25. Site-specific and plant need-based nutrient management.
26. Factors influencing nutrient use efficiency (NUE) in respect of N, P, K, S, Fe and Zn fertilizers.
27. Source, method and scheduling of nutrients for different soils and crops grown under rainfed and irrigated conditions.
28. Integrated plant nutrient supply system and its management.
29. Problems Soils: Definition – Classification – Saline, Saline Sodic and Sodic soils characteristics-Formation and Nutrient availability in problem soils.
30. Acid and Calcareous soils characteristics – Formation and Nutrient availability in acid and calcareous soils.
31. Reclamation of problematic soils – Mechanical, Chemical and Biological methods. Lime requirement – Different liming materials – Organic amendments – FYM, compost, pressmud, problems associated with over liming. Gypsum requirement – Classification of crops based on their tolerance to salts.
32. Irrigation water: Quality of irrigation water – Classification based on EC, SAR, RSC and Boron content. Indian standards for water quality. Use of saline waters in agriculture

Practical

1. Determination of available nitrogen in soils by alkaline permanganate method
2. Determination of organic carbon content by Walkley and Black method
3. Determination of available phosphorus in soils by Olsen's method
4. Determination of available potassium in soils by NH_4OAc method and sulphur by Palaskar method
5. Determination of DTPA extractable zinc in soil
6. Collection of irrigation water sample and determination of pH and EC in irrigation water.
7. Determination of carbonates, bicarbonates and chlorides in irrigation water by acid – base neutralization
8. Determination of Ca and Ca + Mg in irrigation water by EDTA method
9. Determination of sodium and potassium in irrigation water
10. Quick tests and interpretation of soil test and irrigation water analysis data
11. Determination of lime requirement of acid soil
12. Determination of gypsum requirement of alkali soils
13. Collection and processing of plant samples for analysis
14. Determination of nitrogen in plant samples
15. Determination of phosphorus in plant samples
16. Determination of potassium in plant samples

References

- "Soil Science – An Introduction", Indian Society of Soil Sciene, 2015 , New Delhi
- N.C. Brady and RR Weil, "*The Nature and properties of soil*", 14th edition, Pearson Education India
- Tisdale, S.L. Nelson, W.L. and Beaton, J.D. 1993, "*Soil fertility and Fertilizers*", Mac Millan Publishing Co. New York
- Tandon, HLS. 1994, "*Fertilizers Guide*" , Fertilizers Development Consultation Organisation, New Delhi
- Kanwar j.s. (Ed.), 1976 "*Soil fertility:Thoery and practice*", ICAR, New Delhi
- Tandon, HLS. 2nd edition,2005, "*Methods of analysis of soils, Plants, Waters, Fertilizers and organic Manures sample*" Fertilizers Development Consultation Organisation, New Delhi

Course No.: GPMN-3.8.3
Course Title: Fundamentals of Plant Breeding-2 (1+1)
Lecture Outline

Theory

1. Introduction to plant breeding- Scope and importance of plant breeding, Plant breeding in India- major achievements and future goals, different national and international institutes.
2. Modes of reproduction and modes of pollination of crop plants- sexual reproduction (self pollinated, often cross pollinated and cross-pollinated crops), asexual reproduction (apomixis and vegetative propagation). Genetic constitution and significance in plant breeding. Different sex forms.
3. Self incompatibility, classification and use in plant breeding/hybrid seed production. Methods to overcome self incompatibility.
4. Male sterility, different types and their use in plant breeding/hybrid seed production.
5. Different breeding methods followed in self pollinated, often cross pollinated, cross pollinated and clonally propagated crops.
6. Introduction, significance and procedure- NBPGR. Germ plasm collections and conservation.
7. Selection, principles, genetic advance under selection –Johannsen pure line theory and Pure line selection.
8. Mass selection, clonal selection, simple recurrent selection and chance seedling selection
9. Hybridization followed by selection-Pedigree method, bulk method and single seed descent method
10. Breeding for resistance to biotic and abiotic stresses - Gene for gene hypothesis, vertical & horizontal resistance.
11. Back cross method of breeding. Procedure for transfer of dominant genes and recessive genes.
12. Heterosis – manifestation, theories, physiological, biochemical and molecular basis. Inbreeding depression. Combining ability, GCA, SCA.
13. Steps in the development of hybrids- single cross hybrids, double cross hybrids, synthetics, composites.
14. Mutation breeding- physical and chemical mutagens, gamma gardens. Mutation breeding procedure for seed propagated and vegetatively propagated crops,
15. Polyploidy breeding –evolution of important polyploid crop species. Man made polyploids. Inter specific and inter generic crosses.
16. Marker assisted selection - Principles, procedure, merits, demerits, achievements

Practical

1. Light microscopy- study of compound microscope
2. Preparation of micro slides and identification of various stages of mitosis and meiosis.
3. Steps in hybridization and methods of emasculation.
4. Floral biology, emasculation, crossing and selfing techniques in tomato and brinjal.
5. Floral biology, emasculation, crossing and selfing techniques in bottle gourd and ridge gourd.
6. Floral biology, emasculation, crossing and selfing techniques in Mango.
7. Floral biology, emasculation, crossing and selfing techniques in Guava.
8. Floral biology, emasculation, crossing and selfing techniques in Coconut.
9. Floral biology, emasculation, crossing and selfing techniques in Rose.
10. Floral biology, emasculation, crossing and selfing techniques in Marigold.
11. Handling of segregating generations (pedigree, bulk method).
12. Handling of segregating generations (back cross methods).
13. Field layout and maintenance of experimental records.
14. Calculation of heterosis, inbreeding depression.
15. Hybrid seed production.
16. Visit to research stations

References

- Chahal G.S. and Gosal S. S. 2001. Principles and Procedures of Plant Breeding.
- Fehr W.R. 1987 Principles of Cultivar Development –Theory and Practice.

- Poehlman J.M. and D.A. Sleper 1995. Breeding Field Crops.
- Singh B.D. 2008. Plant Breeding – Principles and Methods.
- Singh, B.D 2011. A textbook in Plant Breeding, Kalyani Publishers, Ludhiana.

Course No.: ASMN-3.9.2

Course Title: Principles and Practices of Natural Farming-2 (1+1)

Lecture Outlines

Theory

1. Indian Heritage of Ancient Agriculture, History of Natural Farming
2. Importance of natural farming; Definition; Objective of natural farming. Essential characteristics and Principles of natural farming; Scope and importance of natural farming
3. Main Pillars of natural farming; Methods/ types/ schools of natural farming
4. Introduction to concept of ecological, water, carbon and nitrogen foot prints
5. Concept and evaluation of ecosystem services
6. Rearing practices for animals under natural farming
7. Nutrient management in natural farming and their sources
8. &9. Insect and disease management under natural farming
10. Weed management under natural farming
11. Mechanization in natural farming
12. &13 Processing, labelling, economic considerations and viability, certification and standards in natural farming marketing and export potential of natural farming produce and products
14. Initiatives taken by Government (central/state), NGOs and other organizations for promotion of natural farming and chemical free agriculture
15. Case studies and success stories in natural farming and chemical free traditional farming
16. Entrepreneurship opportunities in natural farming

Practical

1. Field survey for studying plant species diversity and ITKS in a village/region
2. Identification and study of botanicals, animal urine and dung based and other inputs used in natural farming
3. Study of weed management practices in natural farming
4. Study of green manuring in-situ and green leaf manuring practices
5. Techniques of indigenous seed production, storage and marketing
6. &7 Study and preparation of Cow-based bioproducts
8. &9 Study and preparation of bio inputs used in natural farming
10. &11 Study and preparation of plant-extract based bio-inputs
12. Study and preparation of fermented butter milk and Neem -based concoctions
13. Partial and complete nutrient and financial budgeting in natural farming
14. Evaluation of ecosystem services in natural farming (Crop, Field and System)
15. Visit of natural farm and chemical free traditional farms to study the various components and operations of natural farming principles at the farm
16. Visit to an institute involved in cow based natural farming

References

• Ayachit SM. 2002. Kashyapi Krishi Sukti A. Treatise on Agriculture. Brig Sayeed Road, Secunderabad, Telangana: Asian Agri-History Foundation 4: 205.

• UK Behera. 2013. A textbook of Farming System. Agrotech Publishing House, Udaipur. ISBN: 978-81-8321-309-7.

• Fukuoka M. 1978. The One-Straw Revolution: An Introduction to Natural Farming. Rodale Press, Emmaus, PA. 181 pp.

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

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

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

• Nicole F 2016. The Ultimate Guide to Natural Farming and Sustainable Living: Permaculture for Beginners (Ultimate Guides).

• Prathapan Paramu 2021. Natural Farming Techniques: Farming without tilling.

Course No.: ESMJ-3.11.1
Course Title: Information and Communication Technology in Horticulture-3 (1+2)

Lecture Outline

Theory

1. IT and its importance. IT tools, IT-enabled services and their impact on society
2. Anatomy of computers, Computer fundamentals: memory, input and output devices
3. Definition of hardware and software; Types of Software – Operating System, Translators, Programming languages, Application Programmes, Utility Programmes & General Purpose Programmes
4. Classification of Computers; Word and character representation; features of machine language
5. Features Assembly language, high-level language and their advantages and disadvantages
6. Principles of programming- algorithms and flowcharts
7. Operating systems (OS) - definition, basic concepts
8. Introduction to WINDOWS and LINUX Operating Systems
9. MS-WORD: Applications of Word Processing for document creation & Editing
10. MS-EXCEL: Applications of Spreadsheet for graph creation, statistical analysis, mathematical expressions
11. MS-POWERPOINT: Applications of Data presentation and interpretation Database concepts and types
12. MS-ACCESS: Database concepts and types, uses of DBMS in Horticulture
13. Introduction to Local area network(LAN), Wide area network(WAN)
14. Definitions of Internet, World Wide Web, HTML and IP
15. Video conferencing
16. Introduction to e- Horticulture, concepts and applications, Use of ICT in Horticulture.

Practical

1. Creating files, folders, file management in WINDOWS operating system
2. MS WORD: Editing of a document by using copy, cut, paste, font type, font size increasing / decreasing

3. Formatting a document by using bold, italic, underline, font color Operations on change case, save / save as a document
4. Password to protect a document, Paragraph setting: bullets and numbering, alignments
5. Line spacing, find and replace, page break
6. Operations on tables in MS-Word (merge cells, delete a row, insert a row, delete a column, insert a column), mail merge
7. Insert picture, insert page numbers, header and footer, word art, shapes
8. Preparing an id card by using text box, drop cap
9. Inserting statistical equations
10. Page margins, orientation, size, two columns, watermark, Page boarder, page color, spell check, thesaurus and print layout
11. MS-Excel: Paste special, Conditional formatting
12. Preparation of charts / Graphs -Column, line, pie and bar
13. Header and footer (Insert page numbers, date, time),
    Page settings: page margins, size, orientation and print area
14. Conversion of upper case letters or lower case letters, Operations on tables in MS-Excel (merge cells, delete a row, insert a row, delete a column, insert a column)
15. Insert picture, insert page numbers and insert header and footer in MS-Excel
16. Statistical formulae in MS-Excel: total, average, SD, Variance, MAX, MIN, Count Operations on matrices: Matrix inverse, matrix multiplication
17. Statistical Data analysis (Descriptive statistics, correlation) by using MS-Excel
18. If and nested if conditions, trace precedents and trace dependents, text to columns
19. Data validation, what if analysis (goal seek), freeze panes, Views: normal, page layout and page break
20. MS Power Point: Create a power point slide by using following specifications: Slide title, graph / chart on right side, corresponding graph / chart data on left side, action buttons, Color / gray scale
21. Design templates, slide background color, slide layouts, slide numbers
22. Slide transition, animations, automatically after, Views: Normal, slide sorter, slide show, notes page, slide master views
23. MS Access: creating database tables, linking tables by using relationships
24. Generate queries and reports
25. Creation and operation of E mail account
26. Demonstration of Agri-information system using Mobile Apps
27. Internet applications: Web browsing
28. Audio visual aids
29. Planning, preparation, presentation of posters, charts
30. Introduction of Geospatial Technology of generating valuable information for Agriculture
31. Hands on Decision Support System
32. Preparation of contingent crop planning

References:

- Fundamentals of Information Technology- Vinod BabuBandari, Pearson Education, New Delhi, 2012
- Comdex Computer Kit: Windows 7 with Office 2010 – Vikas Gupta, Dream Tech Press,New Delhi
- Fundamentals of Computers, Pearson Education- ITL ESL, New Delhi, New Delhi, 2011
- Gurvinder Singh, Rachhpal Singh & Saluja KK. 2003. Fundamentals of Computer Programming and Information Technology. Kalyani Publishers.
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- Rajaraman V & Adabala N. 2015. Fundamentals of Computers. PHI.

Course No.: PBMJ-3.10.1
Course Title: Growth and Development of Horticultural Crops-3(2+1)

Lecture Outline:
Theory

1. Growth and Development: Definition, types of growth-monocarpic and polycarpic-Phases of growth-Lag phase, Log phase, Stationary phase and Senescent phase. Initiation and development of Vegetative and reproductive organs.
2. Stages of growth: Embryonic, Juvenile, Transitional, Maturity and Senescence; single, double and triple sigmoid growth curves in fruits- factors affecting growth.
3. Growth analysis: Definition, advantages and disadvantages- Study of growth parameters Photosynthetic productivity of horticultural crops, LAI, development of optimum LAI in horticultural crops.
4. Development of Ideal canopy architecture, Canopy photosynthesis and productivity in horticultural crops.

5-6 Crop development, dynamics and physiology of vegetable crops.

7-8 Crop development, dynamics and physiology of Flower crops.

9-10 Crop development, dynamics and physiology of Fruit crops.

11-12 Crop development, dynamics and physiology of Plantation crops.

13-14 Crop development, dynamics and physiology of Spices, Aromatic and medicinal crops.

15. Hormones/Plant growth regulators- Definition, history, classification of plant growth Regulators, synergistic and antagonistic action.
16. Auxins: History, basic functions, biosynthesis- Mechanism of action- Role in crop growth and development (propagation, flowering, fruit setting, parthenocarpy, fruit development fruit drop and fruit ripening etc.).
17. Gibberellins: History, basic functions, biosynthesis- Mechanism of action- Role in crop growth and, development (seed dormancy and germination, propagation, flowering, sex expression, parthenocarpy, overcoming of genetic dwarfism, fruit setting, fruit thinning, fruit development fruit drop and fruit ripening etc.).
18. Cytokinins: History, basic functions, biosynthesis- Mechanism of action- Role in crop growth and development (propagation, removal of apical dominance, remobilization of nutrients, Richmond-Lang effect, flowering, fruit setting, fruit thinning, fruit development and fruit drop, etc.).
19. Abscisic acid: History, basic functions, biosynthesis- Mechanism of action- Role in crop growth and development (seed and bud dormancy, stomatal regulation, senescence and abscission, flowering, fruit setting, fruit thinning, fruit development etc.).
20. Ethylene: History, basic functions, biosynthesis- Mechanism of action- Role in crop growth and development (triple response, root and root hair formation, exudation of latex, senescence, flowering, fruit setting, fruit development, fruit drop and fruit ripening etc.).
21. Growth Retardants: Basic functions, biosynthesis- Role in crop growth and development (propagation, flowering, sex expression, root growth, high density planting, fruit setting, fruit thinning, fruit development, fruit drop, fruit ripening and shelf life etc.).
22. Flowering: Factors affecting flowering- Physiology of flowering- Ripeness to flowering, Definition of photoperiodism- Classification of plants based on photoperiodic response- Long day, short day and day neutral plants.
23. Formation of floral stimulus and its translocation- Role of phytochrome in flowering- Importance of photoperiodism in horticulture.
24. Vernalization: Definition, examples for vernalization in horticulture, site of vernalization, vernalization stimulus- Mechanism of vernalization- Devernalization- Conditions required for vernalization- Importance of vernalization in horticulture.
25. Training & pruning: Definition of Training- Factors affecting training- Pruning definition- Objectives of pruning.
26. Physiological aspects of pruning and Training in horticultural crops.
27. Translocation of assimilates: Source-sink relationship- Components of phloem tissue-Types of assimilate transport- Vein loading and Vein unloading- Symplastic and apoplastic pathways for loading and unloading of assimilates.
28. Theories explaining the short and long distance pathway of assimilate transport in plants and factors affecting assimilate transport in plants.

29. Seed Physiology: Definition of seed- Seed Structures- Development of embryo, endosperm, perisperm and seed coat- Morphological, physiological and biochemical changes during seed development.
30. Physiological Maturity: Morphological and Physiological changes associated with physiological maturity in crops with suitable examples- Harvestable Maturity- Definition of seed viability and vigour- Factors affecting seed viability and vigour.
31. Seed and bud dormancy: Definition, types of seed dormancy- Causes and remedial measures of seed dormancy with examples - Advantages and disadvantages of seed and bud dormancy.
32. Fruit setting and ripening: Definition, physiology of fruit setting and growth- factors affecting the pollination and fruit setting - Physiology of fruit ripening- Climacteric and non-climacteric fruits - Physiology of fruits under post-harvest storage.

Practical

1. Estimation of photosynthetic potential of horticultural crops
2. Measurement of Leaf area by different methods
3. Growth Analysis
4. Preparation of plant growth regulator solutions
5. Identification of synthetic plant hormones and growth retardants
6. Auxin bioassay test
7. Gibberellin bioassay test
8. Cytokinin bioassay test
9. ABA bioassay test (stomatal closure)
10. Ethylene bioassay test (fruit ripening)
11. Physiological control of flowering and fruit drop in horticultural crops
12. Role of hormones in rooting of cuttings in horticultural crops
13. Physiological disorders and their remedial measures in fruits and vegetables
14. Breaking the seed dormancy by use of chemicals
15. Breaking the seed dormancy by use of growth regulators
16. Tests of seed viability and vigour

References:

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- Mohr H and Schopfer P 1995. Plant Physiology. Springer-Verlag, Berlin, Germany.
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- Taiz L and Zeiger E 2003. Plant physiology (Thirdedition). Sinaure Associates, Inc.,Publishers,Massachusettes, USA.

Course No.: ESMN-3.11.2

Course Title: Fundamentals of Extension Education and Rural Sociology-2(1+1)

Lecture Outline

Theory

1. Education: Meaning, definition & Types; Extension Education- meaning, definition, scope and concepts of extension; Objectives and principles of Extension Education;
2. Extension Programme planning- Meaning, Process, Principles and Steps in Programme Development.
3. Extension systems in India: extension efforts in pre independence era (Sriniketan, Marthandam, Firka Development Scheme, Gurgaon Experiment, etc.) and post-independence era (Etawah Pilot Project, Nilokheri Experiment etc.); Community Development Programme, National Extension Service
4. Transfer of technology programmes of ICAR-KVK (Krishi Vigyan Kendra), LLP (Lab to Land Programme), ORP (Operational Research Project), ND (National Demonstration), IVLP (Institute Village Linkage Programme)

5. Monitoring and evaluation: concept and definition, monitoring and evaluation of extension programmes;
6. Rural Leadership: concept and definition, types of leaders in rural context; Methods of identification of Rural Leader.
7. Extension teaching methods: meaning, classification, individual, group and mass contact methods, Agriculture journalism.
8. Audio visual aids-importance, classification and selection
9. Teaching and learning-concepts, principles and teaching steps
10. New trends in agriculture extension: privatization of extension, cyber extension/ e-extension, Market-led extension, farmer-led extension, expert systems
11. Diffusion and adoption of innovation: concept and meaning, process and stages of adoption, adopter categories.
12. Scope, importance and tools of Participatory Rural Appraisal (PRA) and Rapid Rural Appraisal (RRA)
13. Sociology and rural sociology, Meaning, Definition, Scope, Importance of Rural Sociology in Agricultural Extension, Indian Rural Society- characteristics, Differences and Relationship between Rural and Urban societies.
14. Social Groups- Meaning, Definition, Classification and Role of social groups in Agricultural Extension.
15. Social Stratification- Meaning, Definition, Functions, Basis for stratification, Forms of Social stratification- Characteristics and- Differences between Class & Caste System.
16. Cultural concepts- Culture, Customs, Folkways, Mores, Taboos, Rituals and Traditions- Meaning, Definition and their Role in Agricultural Extension.

Practical

1. Visit to Village Panchayat
2. Visit to Mahila Mandal
3. Visit to State Dept. of Horticulture
4. Visit to Farmer Producer Organisation
5. Visit to NGO/ VO to study the developmental activities
6. Visit to All India Radio
7. Planning and writing a script for radio and television
8. Planning and preparation of charts and posters
9. Planning and preparation of information materials - leaflet, folder and pamphlet
10. Visit to a village to conduct the selection of a lay leader based on Sociogram Technique
11. Organizing a group discussion
12. Planning and preparation of news stories
13. Planning and preparation of success stories
14. Understanding PRA techniques and their application in village development planning
15. Visit to a village to list out the taboos, folkways, rituals and social values in the Village
16. Creating a learning situation under village conditions for a specific teaching activity

References

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- Dahama, O. P. and Bhatnagar, O.P., 1998, Education and Communication for Development, Oxfordand IBH publishing Co. Pvt. Ltd., New Delhi.
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- Muthaiah Manoraharan, P. and Arunachalam, R., Agricultural Extension, Himalaya Publishing House (Mumbai).
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- Sandhu, A.S., 1993. Text book on Agricultural Communication: Process and Methods. Oxford and IBH Publishing Pvt. Ltd., New Delhi.
- Singh, A.K., Lakhan Singh, R. and Roy Burman, 2006. Dimensions of Agricultural Extension. AmanPublishing House, Meerut
- J.B. Chitambar -Introductory Rural Sociology
- Ray, G. L. - Extension Communication and Management
- A. R. Desai -Rural Sociology in India
- R. Velusamy Textbook on Rural Sociology and Educational Psychology

Course No.: PTMJ-3.7.1

Course Title: Diseases of Field Crops and Their Management-2 (1+1)

Lecture Outline

Theory

1. Diseases of Rice -Symptoms, disease cycle, etiology, epidemiology and management of blast, brown spot, sheath blight, sheath rot, false smut, bacterial leaf blight, bacterial leaf streak, tungro and khaira.
2. Diseases of Wheat - Symptoms, disease cycle, etiology, epidemiology and management of blast, rusts, loose smut, karnal bunt and tundu disease.
3. Diseases of Maize - Symptoms, disease cycle, etiology, epidemiology and management of banded leaf and sheath blight, southern and northern blight, downy mildew, smut and charcoal rot.
4. Diseases of Sorghum- Symptoms, disease cycle, etiology, epidemiology and management of smuts, grain mold, anthracnose, rust, downy mildew and striga.
5. Diseases of Bajra - Symptoms, disease cycle, etiology, epidemiology and management of downy mildew, ergot, rust and smut.
6. Diseases of Finger millet - Symptoms, disease cycle, etiology, epidemiology and management of blast, smut, mosaic andleaf spot.
7. Diseases of Blackgram and Greengram - Symptoms, disease cycle, etiology, epidemiology and management of corynespora leaf spot, cercospora leaf spot, anthracnose, rust, yellow mosaic, urdbean leaf crinckle and cuscuta.
8. Diseases of Bengalgram - Symptoms, disease cycle, etiology, epidemiology and management of rust, dry root rot, ascochyta blight and wilt. Diseases of Redgram - Symptoms, disease cycle, etiology, epidemiology and management of phytophthora blight, wilt and Pigeonpea sterility mosaic.
9. Diseases of Mustard- Symptoms, disease cycle, etiology, epidemiology and management of white rust, powdery mildew, downy mildew, alternaria leaf spot and sclerotinia stem rot.
10. Diseases of Sunflower - Symptoms, disease cycle, etiology, epidemiology and management of alternaria blight, stem rot, collar rot, downy mildew, rust, powdery mildew, Stem Necrosis Disease (SND).
11. Diseases of Groundnut - Symptoms, disease cycle, etiology, epidemiology and management ofearly and late leaf spots, rust, collar rot, bud necrosis, Stem Necrosis Disease and Kalahasti malady.
12. Diseases of Sesamum - Symptoms, disease cycle, etiology, epidemiology and management of phyllody, alternaria leaf spot, bacterial leaf spot, powdery mildew and charcoal rot. Diseases of Safflower - Symptoms, disease cycle, etiology, epidemiology and management of alternaria blight, wilt and rust.
13. Diseases of Castor - Symptoms, disease cycle, etiology, epidemiology and management of wilt, root rot and grey mildew. Diseases of Soybean - Symptoms, disease cycle, etiology, epidemiology and management of rust, downy mildew and bacterial pustule.

14. Diseases of Tobacco - Symptoms, disease cycle, etiology, epidemiology and management of damping off, frog eye leaf spot, black shank, brown spot, root rot, mosaic and orobanche.
15. Diseases of Cotton - Symptoms, disease cycle, etiology, epidemiology and management of anthracnose, leaf spots, vascular wilts, rust, grey mildew and black Arm.
16. Diseases of Sugarcane - Symptoms, disease cycle, etiology, epidemiology and management of red rot, smut, grassy shoot, ratoon stunting, pokkahboeng and mosaic.

Practical

1. Diseases of Rice- symptoms, etiology and identification.
2. Diseases of Wheat – symptoms, etiology and identification.
3. Diseases of Maize and Sorghum-symptoms, etiology and identification.
4. Diseases of Bajra and fingermillet- symptoms, etiology and identification.
5. Diseases of Greengram and blackgram- symptoms, etiology and identification.
6. Diseases of Redgram and Bengalgram - symptoms, etiology and identification.
7. Field diagnostic visit for disease identification.
8. Diseases of Groundnut- symptoms, etiology and identification.
9. Diseases of Soybean - symptoms, etiology and identification.
10. Diseases of Sunflower and Safflower - symptoms, etiology and identification.
11. Diseases of Castor and Sesamum - symptoms, etiology and identification.
12. Diseases of Mustard- symptoms, etiology and identification.
13. Diseases of Sugarcane- symptoms, etiology and identification.
14. Diseases of Tobacco - symptoms, etiology and identification.
15. Diseases of Cotton - symptoms, etiology and identification.
16. Field diagnostic visit for disease identification.

Note:

- Collection and preservation of plant diseased specimens for herbarium
- Students should submit pressed and well mounted specimens.

References:

- Rangaswami GandMahadevanK. 2001. *Diseases of crop plants in India.* PrenticeHall of Pvt.Ltd, New Delhi.
- Singh, R.S. 2005. *Plant Diseases.* Oxford & IBH Publications, New Delhi.
- Diseases of Field Crops and their management. Editors: S.C. Dubey, Rashmi Aggarwal, T.S.S.K. Patro and Pratibha Sharma Year:2016 / Pages: 650 ISBN:81-7019-528-0 (India), 1-55528-383-7 (USA)
- Diseases of Field Crops and their Management by S. Parthasarathy, G. Thiribhuvanamala, K.Prabakar CRC Press, London. https://doi.org/10.1201/9781003084198

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LECTURE OUTLINES FOR VII SEMESTER COURSES

Course No.: FREL - 4.1.1

Course Title: Good Horticultural Practices-2 (1+1)

Lecture Outline

Theory

1. An Overview on Good Horticultural Practices for horticulture production and export : importance of GHP, key elements of GHP. Important basic standards, benefits and challenges of GHP

2. Good Horticultural Practices for the production of quality planting material, water and nutrient management – water use efficiency methods & INM, post- harvest handling, food safety, IPM, IDM for Horticultural Crops i.e. Mango
3. Good Horticultural Practices of Grape
4. Good Horticultural Practices of Citrus fruits
5. Good Horticultural Practices of Banana
6. Good Horticultural Practices of Papaya, Sapota and Pineapple
7. Good Horticultural Practices of Apple
8. Good Horticultural Practices of warm season vegetables i.e tomato, brinjal, chilli, okra
9. Good Horticultural Practices of cool season vegetables i.e Cabbage, Cauliflower
10. Good Horticultural Practices of root, tubers and bulbs i.e. Tapioca, Potato and Onion.
11. Good Horticultural Practices of Flower crops: Rose, Carnation, Gerbera
12. Good Horticultural Practices of Flower crops: Lisianthus, Gladiolus, Chrysanthemum, Anthurium, Jasmine, Marigold, tuberose
13. Good Horticultural Practices of Plantation crops i.e coconut, Cashew nut, oil palm, Cocoa
14. Good Horticultural Practices of spice crops i.e black pepper, turmeric and coriander
15. Pesticide residue issues in horticultural production and export. Enhancing export of fresh and processed fruits.
16. Food Standards – HACCP, ISO, CODEX, EUREPGAP, EUREP. Export standards of Cut flowers

Practical

1. Good Horticultural practices (GHP), Pre-Planting Measures, Production Measures, harvest, post harvest handling measures
2. Food safety, food safety hazards types - Chemical hazards- Biological hazards-Physical hazards-other hazards
3. Analysis of food safety hazards and good farming practices :Sources of contamination of food and approaches
4. Community, environmental and household mapping: Site feasibility, selection, site maps using field trip for practical site map preparation,
5. Good Horticulture Practices to manage food safety Suitability, selection and management of planting materials *i.e* seeds varieties and root stocks
6. Good Horticulture Practices -management of fertilizers and soil additives
7. Good Horticulture Practices -Irrigation management; quality, safety of material and method of applications.
8. Good Horticulture Practices –pesticides, quality, safety and method of applications
9. Good Horticulture Practices -Harvesting and handling of produce
10. Good Horticulture Practices -Storage methods and standards
11. Guidelines for export standards of mangoes to different countries (Japan and USA)
12. Export standards for bananas (CODEX)
13. Export standards for different important vegetable crops
14. Export standards for different important spice crops
15. Export standards for important flower Crops

16. Visit to NRLs

References

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Course No.: VSEL-4.2.1
Course Title: Hi-tech Horticulture-2(1+1)

Lecture Outline

Theory

1. Introduction to Precision Farming- Definition, Scope, and Concepts. Key components of Precision Farming- Global Positioning System (GPS), Differential GPS (DGPS), Geographic Information System (GIS), Remote Sensing, Applications in crop monitoring, soil assessment, and detecting variability in fields, Robotics in horticulture
2. Site-Specific Management (SSM), Uniform Rate Technology (URT) -Standardized input management methods, SSM vs URT practices, Map-based VRA, Sensor-based VRA.
3. Precision Farming Techniques: Laser-Guided Land Leveling. Modern field preparation and planting methods.
4. Precision farming techniques- Precision seed drills, Mechanized: direct seed sowing; Hi tech Nursery Technology. Seedling and sapling transplanting,
5. Site-Specific Input Applications: Grid-Based Soil Sampling, Preparation of Soil Fertility Maps
6. Site specific input application Variable Rate Technologies (VRT), Fertilizer Application, Weed Management, Pest Management and Irrigation,
7. Yield Mapping Importance in precision farming; methods to collect, analyze, and utilize yield data.
8. AI integration, UAVs, and autonomous farm machinery-Mechanized Harvesting in Horticulture crops.

9. & 10. Vegetable grafting:Introduction – Definition- historical background - Types of Grafting: - Rootstock and Scion Selection-Grafting Process-Benefits - Challenges and Limitations: - Applications in Major Vegetables
11. Micro propagation - Definition, - importance in modern horticulture - Types - Media Composition - Stages of Micro propagation- Benefits - Challenges and Limitations - Applications in Major Horticultural Crops
12. Protected cultivation of high-value horticultural crops- advantages, controlled conditions, methods and technique, Hydroponics, aeroponics etc.,
13. &14 Canopy Management in Horticultural Crops: Definition, objectives, and importance in crop productivity - Pruning: thinning, heading, and rejuvenation - Training: Types of training systems (central leader, open centre, and trellis) and their applications - Effects of Canopy Management: Light interception, air circulation, and disease prevention - Timing and Methods: Optimal timing for pruning and training operations for various crops - Benefits - Challenges and Limitations - Applications in Major Horticultural Crops
15. High-Density Planting in Horticultural Crops: Definition, concept, and significance - Objectives - Key Principles - Types of HDP's - Benefits of High-Density Planting - Challenges and Limitations - Applications in Major Horticultural Crops
16. Growth regulators and biostimulants in crop production- Definition, types, and roles in enhancing plant growth - Types of Growth Regulators - Types of Biostimulants - Mechanisms of Action- Benefits - Challenges and Limitations - Applications in Major Crops

Practical

1. Study of different types of conventional,water-soluble and Nano fertilizers,
2. Micro irrigation systems and their components: EC, pH-based fertilizer scheduling
3. Calculation of fertigation requirements for different Horticultural crops
4. Crop protection using sensors and drones
5. Climate control in greenhouses
6. Protected cultivation of commercial fruits
7. Protected cultivation of Vegetable and cut flowers
8. Training and pruning in important tropical fruit crops
9. Training and pruning in important vegetable crops
10. Training and pruning in important flower crops
11. Hi tech nursery techniques
12. Visit to commercial fruit nursery and high density orchard
13. Visit to a hydroponics unit
14. Visit toTissue culture lab
15. Visit to commercial greenhouses
16. Visit to Hi-techvegetable nursery

References:

- Hi-tech Horticulture by T.A. More
- Greenhouse operation and management by Paul V. Nelson
- Hi Tech Horticulture (Pb), S. Prasad, Dharam Singh and R'L, Bharadwaj, 2020, Agrobios
- Instant Horticulture, S.N.Gupta, Jain Brothers,2023, 488p.
- Hydroponics for Beginners and Advanced: The Ultimate Hydroponic and Aquaponic Gardening Guide, Tom Garden, Webb Eleanor
- Hand book of precision agriculture-Principles and applications Ed. Ancha Srininvasan
- Food product press 2006
- Precision agriculture-Terry. A. Brase 2006
- Geo informatics and nano technology for precision farming SR Reddy, Kalyani Publishers
- 2023

- Precision farming and protected cultivation-Kamal Kishore Patel, Dwaraka, Alpan Kumhare and Sarika Mahore. Prachi Digital 2023

Course No.: FLEL-4.3.1
Course Title: Ornamental Horticulture and landscaping-3(2+1)

Lecture Outline

Theory

1. Definition of Ornamental Horticulture – Importance of Ornamental Horticulture (gardening) – History of gardening – During Aryan Civilization (Epic Era) – Budha Period – Emperor Ashoka period – Gupta period – Mughal Period – British Period – Post Independence Period.
2. Definition of landscape and landscaping – Historical back ground of land scaping – Principles of landscape gardening – Initial approach – Axis – Focal Point – Mass effect – Unity – Space – Divisional Lines – Proportion and Scale – Texture – Time and Light – Tone and Colour – Mobility – Rhythm – Balance – Contrast – Harmony – Vista – Style.
3. Ornamental annuals-Definition-Classification based on purpose, types, growing season with suitable examples- Planting – Manuring – Propagation.
4. Herbaceous perennials – Definition – Introduction – Classification with suitable examples – Herbaceous perennials for plains and for hills – Planting – Manuring – Propagation.
5. &6. Shrubs – Definition – Utility (aesthetic values) – Classification with suitable examples – based on Purpose of growing – Flowering – Foliage – Flowering and foliage – Fragrant shrubs – based on sunlight requirement – shrubs requiring full sunlight – semi shade – intermediate group (semi shade and sun – shrubs – Planting of Shrubs in garden – Specimen shrub – Standard shrub – Shrubbery border – Arrangement of shrubs – According to height and colour – Growing of shrubs – Soil – Climate – Preparation of soil – Planting – Propagation – seeds – Cuttings – layering – After care – Irrigation – weeding – Pruning.
7. Climbers – Definition – Climbers – twiners – ramblers – creepers – Utility (aesthetic values) – Classification with suitable examples – Sunny situation – Partial shade – shade loving climbers – Showy flowering climbers – Climbers with scented flowers – Climbers with attractive foliage – Climbers for pots – Annual climbers – Climbers for hedge making – Classification based on vegetative growth – Heavy climbers – Light climbers – Soil – Digging of pits – Planting of climbers – After care – Manuring – Maintenance.
8. & 9. Ornamental and shady Trees – Definition – Classification based on purpose with suitable examples – Specimen trees – Shady trees – Flowering trees – Avenue or road side trees – Screening trees – Fragrant flowering trees – Pollution controlling trees – Selection of trees based on – Climatic – Soil – availability and Cost factors- Methods of planting – Time of planting – Manuring – Care and Maintenance – Planting Schemes for avenue planting – One kind of flowering tree on both sides – two kinds of flowering trees blooming at one time on both sides of road – Two kinds of flowering trees blooming at different time on both sides of road – shady trees only on both sides of road.
10. Palms & cycads – Definition – Introduction – Utility (aesthetic values) – Classification with examples – Feather leaved Palm – Fan leaved Palm – Propagation – Pot culture – Potting – Re-potting - Potting media – Manuring – Aftercare.
11. Ferns – Introduction – Utility (aesthetic values) – Propagation – Spore – Division of Clumps – Suckers – bulbils – Site of growing – Soil media – Pot culture – re-potting – Irrigation – Indoor culture – Important Examples.
12. Selaginellas – Introduction – Propagation – Cultural hints – Important Examples. Ornamental grasses, Bamboos and reeds – Introduction – Propagation – Soil and climatic requirements – Site of growing – Planting – Important Examples.

13. Cacti – Introduction – Characteristics of Cactaceae – Classification – Pereskieae – Opuntieae – Cereae (8 tribes) with Examples – Site of growing – Natural habitat – Domestication (Housing of cacti) – Propagation – Seeds – Offsets – Grafting – Soil – Climate – Containers – Time and method of planting – Potting – Re-potting – Irrigation – Staking
14. Succulents – Characteristics – Difference between cacti and succulents – Utility (aesthetic values) – Climate – Soil – Housing – Propagation – Seeds – Cuttings – Watering – Re-potting – Summer protection
15. Indoor plants- Definition – Introduction – Utility (aesthetic values) – Propagation – Seeds – layering-cutting- Offsets – Grafting – Soil – Climate – Containers – Time and method of planting – Potting – Re-potting – Irrigation – Staking
16. &17. Garden components or features –Garden walls – Retaining wall – Fences and Gates – Steps – Garden Drives (Gravel and Asphalt) and Paths (Gravel, Brick, Grass, Stone, Crazy pavings) – Arches and Pergolas – Screens – Bridges – Outdoor garden rooms (Gazebos, garden pavilions, band stand, bower and thatched huts) – Garden components or features – Hedges and Edges – Flower bed – Borders – Carpet Bedding.
18. &19. Garden adornments viz., – Garden Seats – Ornamental tubs, urns and Vases – Bird baths – Sun dials – Floral Clocks – Japanese Lanterns – Ornamental Stones – Fountains – statues – Towers – Wells – Plants Containers – Plant Strands.
20. Types of garden – Formal – Informal – Wild Garden – Styles of garden in the world – Mughal Garden – Site and design – Walls and gates – Terrace – Running water – Baradari – Trees and Flowers.
21. &22. Features of English – Italian – French – Persian Gardens-Japanese Garden – Types of Japanese Garden – Hill – Flat – Tea – Passage – Sand Gardens – Features of Japanese Garden-Ponds – Streams – Water falls – Fountains – Islands – Bridges – Water Basins – Stone Lanterns – Stones – Pagodas – Fences and Gates – Vegetation (Ever green, Deciduous and Flowering plants)
23. Famous Gardens of India –Lal bagh (Bangalore) – Brindavan Garden (Mysore) – Government Botanic Gardens (Ootacamud) Mughal garden (Pinjore) – Chandigarh Rose garden.
24. Specialized gardens – Herb garden – Bog Garden – Sunken garden – Topiary Garden – Kitchen garden – Paved garden – Moon Garden – Gardening in hanging baskets – Window garden – vertical garden - Miniature garden – Mini Zoo – Importance of Green house – Conservatory – Lath house – Fernery in ornamental horticulture.
25. Rock Garden – Types of rock Garden – Selection of site – Construction of the Rockery – Planting – Management of the Rockery – Plants for rock garden – Examples of Cacti and succulents, ferns, shrubs, herbaceous plants, bulbs, flowering annuals.
26. Water garden – Informal pool – Formal Pool – Construction – Planting methods – Filling the pool (water course and falls) – Care of the water garden – Plants for water garden – Surface flowering acquatics – Oxygenators – Floaters – Marginals.
27. &28. Roof garden – Need for roof garden – Limitations – Types of roof garden (Private or cooperative) – Planning – Suitability of the roof – Drainage and water proofing – Making of flower beds, pots and containers – Gardening – Concept – Soil Media – Planting – Planting material Examples – Flowering annuals – Herbaceous perennials – Shrubs – Trees – Creepers – Bulbs – water plants – Maintenance of plants.
29. & 30 Bioaesthetic planning- Definition-Objectives. Land scaping – Educational Institutions (Schools and Colleges) – Importance – Need – Planting materials for different areas of institution – Landscaping – Country side and Village homes – Railway stations and railway lines.
31. & 32 Bio-aesthetic planning – cities and towns – national high ways and roads – Air ports-Bus terminus- Planting trees in colonies – Landscaping City parks – Large – medium – small parks – pleasure grounds.

Practical

1. Identification and description of annuals, biennials and herbaceous perennials.
2. Identification of climbers, creepers, foliage and flowering shrubs.
3. Identification of avenue trees, palms and ferns.
4. Identification of ornamental grasses, cacti and succulents.
5. Identification and description of Indoor plants
6. Visit to nearby ornamental garden and study of its layout.
7. Study of planning, symbolising, designing of ornamental gardens.
8. Study of planning, designing of rockery.
9. Study of planning, designing of water garden.
10. Study of planning, designing of shade garden, roof garden
11. Study of planning, designing of hedges and edges.
12. Study of planning, designing carpet bedding
13. Study and creation of terrariums.
14. Study and creation of vertical garden
15. Visit to nearby gardens and nurseries.
16. Visit to nearby recreational and children's corner.

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Course No.: FLEL-4.3.2
Course Title: Value addition of flowers and ornamentals-2(1+1)

Lecture Outline

Theory

1. Scope and prospects of value addition-prerequisites for value addition-global scenario of value addition-Indian scenario of Value addition-value added technology-avenues of value addition-export and marketing
2. &3. Value addition in loose flowers and ornamentals -rose, chrysanthemum, tuberose, marigold, jasmine, champaka, pandanus, clitoria, hibiscus and lotus
4. Types of value added products- Gulkhand, floral tea, rose oil, rose water, Pankhuri, floral dyes, rose sherbet, floral ice creams, sweets, etc
5. Floral Ornaments – Garlands – Floral crowns – Hair decoration – Rangoli – Floral Bouquets –Button holes
6. Floral arrangement – Western style – Principles of Design *viz*., – Emphasis – Balance – Proportion – Rhythm – Harmony – Unity – Elements of Design *viz*., – Line – Form – Texture – Colour
7. Selection of flowers and foliage – Line flowers – Form flowers – Mass flowers – Filler flower – Materials required – Design rules – Types of floral arrangement – Circular – Triangular – Radiating – Crescent – Horizontal Hogarthian curve – Conditioning – Reconditioning of flowers
8. Japanese floral arrangement – Ikebana – Moribana – Nageire – Jiyu-bana-Zen'ei-ka – Zen'eibana- Morimono – Materials required – General rules – for Moribana and Nageire styles of arrangement – Basic styles of Moribana and Nageire – Basic upright and Basic slanting arrangements.
9. Dry flower technology-Different drying methods-Sun drying, air drying, microwave oven drying, Hot air oven drying, Embeded drying, freeze drying, Glycerine drying-Storage and packing.

10. Tinting-Definition- advantages-chemicals used for tinting-methodology-potential flowers for tinting

11. Essential oils - Definition- Selection of species and varieties (including nonconventional species)- extraction methods- Packing and storage- Aromatherapy.
12. & 13 Pigments-Definition-Types of pigments, carotenoids, anthocyanins, chlorophyll, betalains; Significance of natural pigments as nutraceuticals- Extraction methods and applications in food, pharmaceutical and poultry industries.
14. & 15 Synthetic and Natural dyes-mordants-types of mordants-natural dyes from ornamentals-method of extraction- drying techniques -applications of natural dyes
16. Speaking flowers- suitable flowers, equipment or machinery for making speaking flowers.

Practical

1. & 2. Practices in preparation of Western flower arrangements
3. & 4. Practices in preparation of Japanese flower arrangements
5. Practices in preparation of flower ornaments - button-holes, flower baskets, corsages, floral wreaths, garlands with fresh flowers
6. Preparation of dry flower arrangements- Pot pourri, Greeting Cards, Photo frames, Wall hangings, Candle decorations.
7. Practices in preparation of Gulkhand
8. Practices in preparation of Rose water
9. Practices in preparation of floral teas
10. Practices in preparation of floral soaps
11. Economics of value added products.
12. Practices in Tinting of flowers
13. Practices in Skeletonization
14. Extraction of pigments from flowers
15. Visit to Essential oil extraction units
16. Visit to Florist shops

References:

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- Sachi Gupta Sanjay Pathak and Atul Yadav. 2019. Advances and value addition in flower crops. Weser Books.
- T.K. Bose, L.P Yadav, P.Pal, P. Das, V.A. Parthasarathy.2002. Commercial flowers Vol-1. Naya Prokash
- S.K. Bhattacharjee and L.C.De. 2002. Advanced Commercial Horticulture 2nd Edition Vol1 &2. Aavishkar Publishers, Distributors
- Kuntal Das. 2013. Essential oils and their applications. New India Publishing agency
- P.Aruna, T.L. Preethi, V. Ponnuswami, V. Swaminathan and R. Sankaranarayanan. 2011.Post harvest techniques and management for Dry flowers. New India Publishing Agency

Course No.: PHEL-4.5.1

Course Title: Postharvest Management of Horticultural Crops-3(2+1)

Lecture Outline

Theory

1 Importance of Postharvest Management of horticultural crops

Importance & scope of PHM of horticultural produce – Nutritional aspects. National Economy, Area and production of fruits and vegetables in India and Andhra Pradesh, extent of PHT losses, Factors affecting postharvest losses. Control of post-harvest losses

2. 2.Structure of fruits and vegetables.
   Protective tissue, Ground system, Vascular system and textural characteristics.
3. 3.Pre-harvest factors – Environmental factors (a) light (b) temperature (c) wind (d) rainfall. Cultural operations: Variety, topography of orchard, soil conditions, root stock, water, natural management, training and pruning and harvesting types
4. & 5.Factors responsible for deterioration of Horticulture produce
   1.Respiration 2. Transpiration 3. Ethylene 4. Mechanical damage 5. Pest and diseases – pests: Fruit flies (*Dacus* species), control measures – Orchard sanitation and adult trapping. Diseases (Pathogen) – *Colletotrichum* sp. *Botrytis, Xanthomonas, Phytophthora, Aspergillus, Rhizopus* and its control measures. Post harvest control measure – cold sterilization, ionizing radiation – Di-electric heating, hot-water treatment, Vapour heat treatment, Physiological disorders – internal browning, black heart chilling and freezing injury
6. Fruit ripening :Physiological and Biochemical changes: Physiological – Softening, Physiological loss in weight (PLW), texture, respiration and transpiration, Bio-chemical changes – Change in carbohydrates, organic acids, pigments, phenolic compounds, flavouring compounds, enzyme activity.
7. 8 & 9.Definition of maturity, methods to determine maturity – visual means, physical methods, chemical methods, computation, physiological methods –
   Maturity indices of fruits – Banana, Grapes, Sweet orange, Mango, Papaya, Pineapple, Guava, Pomegranate, Sapota, Custard apple, Ber, Fig, Aonla, Litchi, Passion fruit, Persimmon, Avocado, Jackfruit, Apple, Pear, Peach, Plum, Apricot, Strawberry, Almond.
   Maturity indices of vegetables – Tomato, Brinjal, Chilli, Okra, Cucurbits, Peas, Cabbage, Cauliflower, Cucumber, Beans, Onion, Carrot, Radish, Beetroot, Watermelon, Musk lemon, Potato, Tuber crops, Yams, Drumstick.
   Maturity indices of flowers – Rose, Marigold, Carnation, Crossandra, Anthurium, Jasmine, China aster, Dahlia, Gerbera, Gladiolus, Chrysanthemum, Orchids, Tuberose, Bird of paradise,
10. &11.Harvesting:Definition, methods of harvesting, manual harvesting, mechanical harvesting – Advantage and disadvantages:
12. & 13.Handling: (1) Removal of heat of the produce – Pre-cooling, methods of pre-cooling – hydro cooling, vacuum cooling, air cooling and contact icing. (2) Pre-packaging – Definition, curing, degreening, disinfestations and waxing. (3) Pack house operations – Cleaning, grading and packing – Handling sequence of pack house operations. (4) Damage in the transport bruising – compact and impact injuries.
14. & 15.Grading:
   Definition, benefits of grading type of grading – Quality grading and grading for size. Methods of grading – hand grading, machine sizing – Equipment for machine sizing – sizing by weight, sizing by diameter. Grading of fruits: Mango, Sweet orange, Papaya, Pineapple, Grapes, Banana, Guava. Grading of vegetables – Tomato, Okra, Cabbage, Cauliflower, Cucumber, Onion, Brinjal, Potato.
16. Harvesting, Handling and Grading of cut flowers, medicinal and aromatic crops
   Anthurium, Gerbera, Lily, Orchids, Rose and Tuberose. Medicinal plants – Rouvolfia, Coleus, Ashwaganda – Aromatic plants – Lemon grass, Vanilla, Davanam, Eucalyptus.
17. Ripening Regulation:
   Hastening ripening – Ethylene and ethylene releasing compounds, smoke, alcohols, Fatty acid.
   Delaying ripening – 2, 4D, 2,4,5 T and 2,4,5 TIBA
18. Postharvest treatments – Washing-Washing Equipments, Use of growth regulators, hot water dip, Fungicidal treatment, In-package treatment, Waxing and Irradiation.

19. Methods of storage for local market and export

a. Traditional storage: (Local market) On site storage (*in-situ*), clamp storage, cellars / underground storage, Evaporative cool storage, Pit storage, Barns, Night ventilation

20. 21.(B) Improved storage methods (Export): Cold storage (Refrigerator storage) Modified atmospheric Storage (MAS), Silicon membrane technology, Controlled atmospheric (CA) storage and Hypobaric storage.
22. & 23.Type of packaging:
    Groups of packaging materials (A) Shipping containers (B) Retail containers
    Packing methods:
    Individual fruit packing, Corrugated Fiber Board (CFB)/Cartons/Cases, Bulk packing, Modified atmospheric packaging (MAP) (Active and Passive), Packing with divisions, Consumer size packing (Pre-packaging).
24. & 25.New innovation in packing materials
25. Active packaging: major active packaging systems –
    Oxygen scavenging systems 2. Moisture absorbing and controlling system 3. CO_2 generating system 4. Ethanol generators 5. Ethylene absorbents 6. Edible coatings.
26. ,27 & 28Types of containers and Cushioning materials
    A) Paper board and fiber board: Advantages and Disadvantages (B) Plastics: Advantages and Disadvantages (i) Poly styrene (ii) Polyvinyl Chloride (PVC) (iii) Polyvinyledene chloride (PVDC) (iv) Polyethylene (v) Polypropylene (C) Rigid plastic containers
    B) Cushioning materials: Properties and types like Paper waste, paddy straw, banana leaf *etc*.
29. Vacuum packaging and Shrink films: Definition, Advantages and Disadvantages. Grape guard packing treatments: Types of grape guards (i) Slow release type (ii) Quick release type
30. Mode of transport: By road (i) Truck or Railway wagon, (ii) Sea or waterway by ship or barges and (iii) by air craft, Hazard in Manual Handling and Minimization of Handling Losses.
31. & 32.Quality and grades specifications

Practical

1. Practice in judging the maturity of various horticultural produce
2. Determination of physiological loss in weight and quality
3. Grading of horticultural produce
4. & 5.Post harvest treatment of horticultural crops, physical and chemical methods
6. & 7 Packaging studies in fruits, vegetables by using different packing material
8. Packaging studies in plantation crops and cut flowers by using different
9. packing material
10. Methods of storage
11. Post harvest disorders in horticultural crops
12. Pulsing and tinting of flower and ornamental crops
13. Vase life extension of Flowers
14. &15 Identification of storage pest and diseases of Horticultural produce
16. Visit to market, pack houses and cold storages

References:

- Post harvest technology of fruits and vegetables - Thompson, A.K. 1996. Blackwell science, London.
- Principles and practice of Post Harvest Technology - Pandey, P.H. 1998. Kalyani Publishers, Ludhiana.
- Post harvest technology of horticultural crops - Sudheer, K.P. 2007.New India, Publishing Agency, New Delhi.
- Physiology and post harvest management of horticultural crops - Singh, D.K. 2001. Pointer, Jaipur.
- Post harvest management of horticultural crops - Mir, M.A. 2005. Agrotech Publishing agency,Udaipur. Rajasthan, India.
- Post harvest physiology of perishable plant products - Kays and Stanley, J. 1998. CBS

Publishers & Distributors, New Delhi.

- Fruit and vegetable processing - Bhatti Suman 1995. Vame, CBS Publishers & Distributors, New Delhi.
- Post Harvest Management of Horticultural Crops - Saraswathy, S. Preethi, T.L. Balasubramanyan, S. Suresh, J. Revathy, N. and Natarajan, S. 2007. Agrotech Publishing Agency, Udaipur.

Course No.: ENEL-4.6.1
Course Title: HORTI-CLINICS (Entomology &Pl. Pathology, Soil Science)- 1 (0+1)

Lecture Outline

Practical

1. Identification of Insect pests and study of insect mouth parts in relation to damage symptoms.
2. Field inspection and collection of sucking pests and their infested plant parts and insect vectors of plant pathogens.
3. Field inspection and collection of borer pests and defoliators and their infested plant parts.
4. Diagnosis of insect damage symptoms in seed, seedlings, stem and leaves in horticultural crops and their management
5. Diagnosis of insect damage symptoms in buds and flowers, roots and tubers in horticultural crops and their management
6. Diagnosis of insect damage symptoms in fruits of various horticultural crops and their management
7. Damage caused by non-insect pests like mites, nematodes, snails, birds, rodents, bats, wild boars and other mammals in important horticultural crops
8. Study of symptomatology and distinguishing characters of various diseases by visual observations.
9. Diagnosis of fungal and bacterial diseases of horticultural crops and their management
10. Diagnosis of viral, viroid and phytoplasma diseases of horticultural crops and their management
11. Detection and diagnosis of seedborne diseases of horticultural crops and their management
12. Collection and microscopic examination of diseased samples & preparation of specimens
13. Rapid Field diagnostic kits/methods for plant diseases
14. Macro and Micronutrient deficiency and toxicity symptoms in horticultural crops and their management
15. Identification of various physiological disorders in annual and perennial horticultural crops and their management.
16. Diagnosis of complex symptoms due to plant pathogens, insect pests, toxicity / deficiency of nutrients (nutritional disorders) and pesticide toxicity.

References:

- David B.V. and Ramamurthy, V.V 2001. Elements of Economic Entomology. Popular Book Depot, Chennai.
- K.P. Srivastava. A Text Book on Applied Entomology Vol. I&II. , Kalyani Publishers, Ludhiyana
- Emmanuel, N, A. Sujatha, T.S.K. K. Kiran Patro, MLN Reddy, B. Srinivasulu, T Samuel SK Patro. Text Book on Integrated Pest Management of Horticultural Crops Astral International Publishers, New Delhi.

Course No.: ENEL-4.6.2
Course Title: Agrochemicals (Entomology & Pl. Pathology, Soil Science)- 2(1+1)

Lecture Outline

Theory

1. History of chemical control; Pesticide use and pesticide industry in India. Definitions and toxicology of pesticides.
2. Pesticide formulations – Types and uses.
3. Introduction and Classification of insecticides and acaricides based on mode of entry, mode of action and chemical nature; categorization of insecticides on the basis of toxicity.
4. Structure and mode of action of organochlorines, organophosphates, carbamates, pyrethroids, tertiary amines.
5. Structure and mode of action of neonicotinoids, oxadiazines, phenyl pyrazoles, insect growth regulators, microbials, botanicals, new promising compounds/ new insecticide molecules; nanopesticides; drawbacks of insecticide abuse.
6. Fate of insecticides in soil & plant. Insecticide residues, their significance and environmental implications; procedures and insecticide and fungicide resistance and their management.
7. Pesticide residue analysis. Insecticide Act, registration procedures, Pesticides banned, withdrawn and restricted use, label claim, and quality control of pesticides; safe use of pesticides; diagnosis and treatment of insecticide poisoning.
8. History, classification and formulations of Fungicides.
9. Non-systemic fungicides - copper sulphate, copper oxychloride and copper carbonate & their Disease control.
10. Organic & Inorganic sulphur fungicides –Mode of action and their disease control (Dithiocarbamates).
11. & 12 Systemic fungicides - Benzimidazole, Phenyl alanine, alkyl phosphonates, triazoles, strobilurin - mode of action and their control.
13. Study of New generation fungicides.
14. Plant protection appliances - Safety precautions
15. Herbicides -Major classes, properties and important herbicides. Fate of herbicides.
16. Fertilizers and their importance: mode of action of various nitrogen, phosphorous and Potash fertilizers- Complex fertilizers

Practical

1. Pesticide formulations and mixtures
2. Bioassay techniques, Evaluation of insecticide toxicity, Probit analysis.
3. Field evaluation of Insecticides against pests.
4. Bio-safety evaluation of Pesticides to beneficial insects;
5. Maintenance of Pesticide applicators and Pesticide Dosage calculations.
6. Compatibility and Phytotoxicity studies of agrochemicals.
7. Pesticide residue analysis in horticultural commodities.
8. Preparation of Bordeaux paste and mixture.
9. Seed treatment methods against diseases and pests of horticultural crops.
10. *In-vitro*evaluation of Fungicides against facultative plant pathogens.
11. *In-vitro*evaluation of Fungicides against obligate plant pathogens.
12. Comparative analysis of different methods of application of fungicide against diseases.
13. Detection methods of fertiliser adulteration
14. Calculation of fertiliser requirements in horticultural crops based on soil tests
15. Visit to pesticide formulation and residue laboratory.
16. Visit to agrochemical retail shop.

References:

- Buchel KH (Ed.) 1992. Chemistry of pesticides. John Wiley & Sons
- Panda H. 2022.The Complete Technology Book on Pesticides, Insecticides,
- Fungicides and Herbicides (Agrochemicals) with Formulae, Manufacturing

- Process, Machinery & Equipment Details 2nd Revised Edition. NPCS
- Biswas D. R. 2021. A Text Book of Fertilizers. New India Publishing Agency
- Singh, A., 2022 Basics of Agrochemical Formulations:, Brillion Publishing, 176p.
- Larramendy, M.L 2017Toxicity and Hazard of Agrochemicals:,INTECH, 170p.

Course No.: PTEL-4.7.1
Course Title: Biological control, Biopesticides and Biofertilizers -2 (1+1)
(Plant protection – Entomology &Pl. Pathology)

Lecture Outline

Theory

1. History and scope of biological control - Principles of classical biological controlimportation, augmentation and conservation.
2. Definitions, concepts and classification of bio pesticides *viz.* fungal pathogen, botanical pesticides, and bio rationals.
3. Biological control of crop pests utilizing successful parasitoids.
4. Role of important Predators in Biological control of crop pests.
5. Potential Entomopathogens against crop pests and their historical role in insect pathology and infection by various microorganisms - bacteria, fungi, viruses *etc*.
6. Entomopathogenic nematodes (EPN) in horticultural crop pest management. Biological control of weeds using insects and fungi.
7. Management of diseases of horticultural crops using fungal biocontrol agents
8. Management of diseases of horticultural crops using bacterial biocontrol agents.
9. Quality control of bioagents and Quarantine regulations.
10. Mass production techniques for biocontrol agents against crop pests.
11. Mass production techniques for biocontrol agents against crop diseases.
12. Bio-pesticides, Botanicals and their application methods against crop pests and diseases.
13. Introduction, status and scope of Biofertilizers. Symbionts, Free living and Associate biofertilizers - characteristics features of bacterial biofertilizers (*Azospirillum, Azotobacter, Bacillus,Pseudomonas, Rhizobium* and *Frankia*); Cyanobacterial bio fertilizers (*Anabaena, Nostoc, Hapalosiphon*) and fungal biofertilizers – (Arbuscular mycorrhiza and ectomycorrhiza).
14. Mechanism of phosphate solubilisation and phosphate mobilization, K solubilisation. Production Technology: Strain selection, sterilization, growth and fermentation, mass production of solid and liquid biofertilizers.

15-16.Specifications and quality control of biofertilizers, Application technology for seeds, seedlings, tubers, sets etc. Biofertilizers-Storage, shelf life, quality control and marketing. Factors influencing the efficacy of biofertilizers.

Practical

1. Identification and mass multiplication of common parasitoids of crop pests.
2. Identification and rearing of successful predators of crop pests.
3. Mass production of entomopathogenic fungi (EPF) of crop pests.
4. Mass production of common entomopathogenic bacteria (EPB) of crop pests.
5. Mass production of NPV against crop pests.
6. Field collection and preservation of parasitoids, predators, cadavers and weed killers.
7. Field release/application of parasitoids and predators against crop pests
8. Bioassay of biopesticides and entomopathogens against crop pests.
9. Isolation and purification of *Trichoderma* spp and its production.
10. Isolation and purification of *Pseudomonas* spp and its production.
11. Isolation and purification of *Bacillus* spp and its production.
12. *In-vitro* evaluation of fungal and bacterial bioagents
13. Identification, extraction and bioassay of important botanicals against crop pests and diseases.

14. Isolation and purification of *Azospirillum*, *Azotobactor*, *Rhizobium*, P-solubilizers and mycorrhiza.
15. Mass multiplication of biofertilizers.
16. Visits to bio-control laboratories.

References:

- Baker, E.F. and James, R.C. 1982. Biological Control of Plant Pathogens. American Phytopathological Society
- Boland, G.J. and David, L.1998. Plant microbe interactions and Biological Control. Kuykendall Marel Dekker, INC.
- Borkar,S.G. 2015.Beneficial Microbes as Biofertilizers and its Production Technology
- Ciancia, A. and Mukerji, K.J. 2007. General Concepts of Integrated Pest and Disease Management. Edited Published by Springer.
- Handbook of Microbial Biofertilizers- Dr. Awani Kr. Singh, Agrotech Press, Jaipur,India
- Biofertilizers for Sustainable Agriculture- Sampat Nehra, Aavishkar Publishers, Jaipur,India
- Organic Farming- A.K. Singh, New India Publishing Agency,New Delhi
- Earthworm Vermiculture and Vermicomposting, R.K. Bhatnagar, R.K. Palta, Kalyani Publishers

Course No.: GPEL-4.8.1

Course Title: Breeding of Horticultural Crops-3(2+1)
Lecture Outline

Theory

1	Classification of horticultural crops with reference to plant breeding - self- pollinated, cross pollinated and often cross pollinated; seed propagated and vegetatively propagated; annuals and perennials. Genetics constitution of different categories.
2	Breeding methods of self-pollinated, cross pollinated and vegetatively propagated crops.
3	Products of plant breeding -varieties, hybrids, synthetics and composites their genetic constitution and multiplication.
4	Male sterility and self-incompatibility – different types and their utilization in breeding/seed production of horticultural crops.
5	Centres of origin, distribution of species- genetic resources/germplasm collections/wild relatives - in different horticultural crops – their utilization and conservation.
6	Modern innovative breeding approaches- introgressive breeding- haploid breeding- transgenic breeding- gene pyramiding-marker assisted selection etc.
7 & 8	Breeding objectives, inheritance of important traits, genetic resources, conventional and modern breeding methods for improvement of yield, quality, biotic and abiotic stress tolerance in tomato and achievements.
9	Breeding objectives, inheritance of important traits, genetic resources, conventional and modern breeding methods for improvement of yield, quality, biotic and abiotic stress tolerance in brinjal and achievements.
10	Breeding objectives, inheritance of important traits, genetic resources, conventional and modern breeding methods for improvement of yield, quality, biotic and abiotic stress tolerance in chilli and achievements.
11	Breeding objectives, inheritance of important traits, genetic resources,conventional and

modern breeding methods for improvement of yield, quality, biotic and abiotic stress tolerance in okra and achievements.

12 Breeding objectives, inheritance of important traits, genetic resources, conventional and modern breeding methods for improvement of yield, quality, biotic and abiotic stress tolerance in bottle gourd, ridge gourd, bitter gourd and achievements.

13 Breeding objectives, inheritance of important traits, genetic resources, conventional and modern breeding methods for improvement of yield, quality, biotic and abiotic stress tolerance in cabbage and cauliflower and achievements.

14 Breeding objectives, inheritance of important traits, genetic resources, conventional and modern breeding methods for improvement of yield, quality, biotic and abiotic stress tolerance in onion and achievements.

15 Breeding objectives, inheritance of important traits, genetic resources, conventional and modern breeding methods for improvement of yield, quality, biotic and abiotic stress tolerance in potato and achievements.

16 & 17 Breeding objectives, inheritance of important traits, genetic resources, conventional and modern breeding methods for improvement of yield, quality, biotic and abiotic stress tolerance in mango and achievements.

18 Breeding objectives, inheritance of important traits, genetic resources,conventional and modern breeding methods for improvement of yield, quality, biotic and abiotic stress tolerance in guava and achievements.

19 Breeding objectives, inheritance of important traits, genetic resources, conventional and modern breeding methods for improvement of yield, quality, biotic and abiotic stress tolerance in banana and achievements.

20 Breeding objectives, inheritance of important traits, genetic resources, conventional and modern breeding methods for improvement of yield, quality, biotic and abiotic stress tolerance in acid lime and sweet orange and achievements.

21 Breeding objectives, inheritance of important traits, genetic resources, conventional and modern breeding methods for improvement of yield, quality, biotic and abiotic stress tolerance in papaya and achievements.

22 Breeding objectives, inheritance of important traits, genetic resources, conventional and modern breeding methods for improvement of yield, quality, biotic and abiotic stress tolerance in watermelon and achievements.

23 Breeding objectives, inheritance of important traits, genetic resources, conventional and modern breeding methods for improvement of yield, quality, biotic and abiotic stress tolerance in musk melon and achievements.

24 & 25 Breeding objectives, inheritance of important traits, genetic resources, conventional and modern breeding methods for improvement of yield, quality, biotic and abiotic stress tolerance in rose and achievements.

26 Breeding objectives, inheritance of important traits, genetic resources, conventional and modern breeding methods for improvement of yield, quality, biotic and abiotic stress tolerance in chrysanthemum and achievements.

27 Breeding objectives, inheritance of important traits, genetic resources, conventional and modern breeding methods for improvement of yield, quality, biotic and abiotic stress tolerance in marigold and achievements.

28 Breeding objectives, inheritance of important traits, genetic resources, conventional and modern breeding methods for improvement of yield, quality, biotic and abiotic stress tolerance in jasmine and achievements.

29 Breeding objectives, inheritance of important traits, genetic resources, conventional and modern breeding methods for improvement of yield, quality, biotic and abiotic stress tolerance in coconut and achievements.

30 Breeding objectives, inheritance of important traits, genetic resources, conventional and modern breeding methods for improvement of yield, quality, biotic and abiotic stress tolerance in oil palm and achievements.

31 Breeding objectives, inheritance of important traits, genetic resources, conventional and modern breeding methods for improvement of yield, quality, biotic and abiotic stress tolerance in cashew nut and achievements.

32 Breeding objectives, inheritance of important traits, genetic resources, conventional and modern breeding methods for improvement of yield, quality, biotic and abiotic stress tolerance in ginger and turmeric and achievements.

Practical

1. Floral biology, emasculation and hybridization techniques in mango.
2. Floral biology, emasculation and hybridization techniques in guava.
3. Floral biology, emasculation and hybridization techniques in papaya.
4. Floral biology, emasculation and hybridization techniques in tomato.
5. Floral biology, emasculation and hybridization techniques in onion.
6. Floral biology, emasculation and hybridization techniques in okra.
7. Floral biology, emasculation and hybridization techniques in bottle gourd.
8. Floral biology, emasculation and hybridization techniques in rose.
9. Floral biology, emasculation and hybridization techniques in marigold.
10. Floral biology, emasculation and hybridization techniques in coconut.
11. Floral biology, emasculation and hybridization techniques in cashew.
12. Calculation of heterosis and inbreeding depression
13. Handling, preparation and use of chemical mutagens.
14. Visit to research stations of fruit and plantation crops.
15. Visit to breeding plots of vegetable and flower crops.
16. Maintenance of records of segregating populations of pedigree, bulk and back cross methods.

References:

1. Anil Kumar Shukla. 2004. Fruit Breeding approaches C Achievements.
2. Bhattacharjee, S.K., De, L.C. 2003. Advanced Commercial Floriculture. Aavishkar Publishers, Distributors, Jaipur (Rajasthan), India.
3. Hari Hara Ram. 2013. Vegetable Breeding: Principle and Practices. Kalyani Publishers, Ludhiana.
4. Kumar, N. 1997. Breeding of Horticultural Crops, Principles and Practices. New India Publishing Agency, New Delhi.
5. Phundan Singh. Elements of Genetics, Kalyani Publishers, New Delhi.
6. Prem Singh Arya. 2003. Vegetable breeding, production and seed production, Kalyani Publishers, New Delhi.
7. Singh B.D. 2008. Plant Breeding – Principles and Methods.
8. Singh, B.D 2011. A textbook in Plant Breeding, Kalyani Publishers, Ludhiana.

Course No.: PBEL-4.10.1

Course title: Molecular Aspects of Abiotic Stress Management in Horticultural Crops-2(2+0)

Lecture Outline

Theory

1. Overview of abiotic stresses in crops: Definition and types (drought, water logging, salinity, temperature, light, heavy metals, etc.) impact on horticultural crop yield and quality.

2. Economic significance of abiotic stress management: Global horticultural market and sustainability, yield losses due to abiotic stress.
3. Plant responses to abiotic stress: drought, water logging, temperature,
4. Plant responses to abiotic stress: light, salinity and heavy metals.
5. Role of reactive oxygen species (ROS) and antioxidants in stress response.
6. Molecular responses. Stress perception: Receptors, signalling pathways for water stress (drought and water logging).
7. Molecular responses. Stress perception: Receptors, signalling pathways for temperature stress (high and low temperature)
8. Molecular responses. Stress perception: Receptors, signalling pathways for light stress (high and low light)
9. Molecular responses. Stress perception: Receptors, signalling pathways for heavy metal and salt stress.
10. Key molecular pathways: ABA (abscisic acid), calcium signalling. Cross-talk between hormonal pathways in stress response.
11. Genomic approaches: Stress tolerance genes, key genes involved in water stress tolerance (Drought and water logging).
12. Genomic approaches: Stress tolerance genes, key genes involved in temperature stress tolerance (high and low temperature).
13. Genomic approaches: Stress tolerance genes, key genes involved in light stress tolerance (high and low light).
14. Genomic approaches: Stress tolerance genes, key genes involved in heavy metal and salt stress tolerance.
15. Proteomic approaches: cellular protection, osmotic adjustment, metabolism, ion homeostasis, general defence, genes encoding proteins in response to water stress (drought and water logging)
16. Proteomic approaches: cellular protection, osmotic adjustment, metabolism, ion homeostasis, general defence, genes encoding proteins in response to temperature stress (high and low temperature)
17. Proteomic approaches: cellular protection, osmotic adjustment, metabolism, ion homeostasis, general defence, genes encoding proteins in response to light stress (high and low light)
18. Proteomic approaches: cellular protection, osmotic adjustment, metabolism, ion homeostasis, general defence, genes encoding proteins in response to heavy metal and salt stress.
19. Metabolomics approaches: carbohydrates (sucrose, sugar alcohols and other polyols).
20. Metabolomics approaches: nitrogenous compounds (glycine betaine and poly amines).
21. Future directions and emerging trends: Integrating omics technologies for stress management: Proteomics, metabolomics, and epigenomics and systems biology approaches
22. Antioxidant defence mechanisms enzymatic and non-enzymatic antioxidants. Role in mitigating oxidative stress

23. Stress-induced secondary metabolites: Role of phenolics, flavonoids, and other compounds. Enhancing stress tolerance through metabolic pathways
24. Climate change and abiotic stress: Impact of climate change on various abiotic stresses in horticultural crops.
25. Role of plant hormones (ABA, ethylene, salicylic acid, jasmonic acid) in stress tolerance mechanism.
26. Tolerance mechanisms to drought stress in horticultural crops: Mechanisms of drought perception, osmotic adjustment and stomatal regulation etc.,
27. Heat stress responses in horticultural crops: Heat stress tolerance mechanisms (heat shock proteins, membrane stability)
28. Heat stress tolerance mechanisms: Heat shock proteins, membrane stability (genetic and biotechnological approaches for enhancing tolerance.
29. Cold stress tolerance mechanisms: Cold stress sensing and adaptive mechanisms (antifreeze proteins, osmo-protectants).
30. Salt stress signalling and response (ion homeostasis, na^+/k^+ balance), engineering cold- and salt-tolerant horticultural crops.
31. Oxidative stress and ROS scavenging systems: Role of reactive oxygen species (ROS) in plant stress, antioxidant defence mechanisms (enzymatic and non-enzymatic systems), role of redox signalling in stress adaptation.
32. Strategies for improving tolerance to different abiotic stress conditions in horticultural crops.

References:

1. *Plant Stress Physiology* by Sergey Shabala
2. *Molecular Plant Abiotic Stress* by HeribertHirt
3. Research articles and case studies from peer-reviewed journals like *Plant Physiology*, *Journal of Experimental Botany*, etc.

Course No.: PBEL-4.10.2

Course Title: Agricultural Microbiology and Phyto-remediation-2(1+1)

Lecture Outline

Theory

1. Introduction to Microbiology: Definition, applied areas of Microbiology and their importance
2. Discovery of microorganisms, spontaneous generation theory,Germ theory of diseases, Immunization, fermentation and origin of life
3. Bacteria: cell structure, chemoautotrophy, photo autotrophy, growth. Bacterial genetics: Genetic recombination- transformation, conjugation and transduction
4. Air Microbiology: Phyllosphere microflora, Phylloplane microflora, microflora of floral parts etc.

5. Food Microbiology: Microbial spoilage and principles of food preservations, Food poisoning.
6. Water Microbiology: Types of water, water microorganisms, and microbial analysis of water e.g. coliform test, Purification of water.
7. Industrial Microbiology: Microbial products, Biodegradation, Biogas production, Biodegradable plastics *etc*.
8. Biological control: Microbial biopesticides for plant disease management. Concepts of rhizosphere microbiology- Potential of plant growth promoting rhizobacteria (PGPR) and endophytes on soil health and sustainability
9. Phytoremediation of polluted soils using microbial mediators-Definition-advantages and disadvantages of phytoremediation-Types of Phytoremediation
10. Criteria for selection of plants used in phytoremediation- Metal uptake-translocation-accumulation- biotransformation
11. Mechanisms of phytoremediation
12. Types of metal binding proteins and their use in phytoremediation
13. Use of biochar-chemicals and root exudates in phytoremediation
14. Plant -microbe interaction-PGPMs- different biological processes in phytoremediation
15. Use genetic engineering and wet land construction strategies in phytoremediation

Practical

1. Study of microscope
2. Acquaintance with laboratory equipment
3. Microscopic observation of different groups of microorganisms
4. Direct and Indirect staining
5. Gram staining of bacteria
6. Study of phyllosphere and rhizosphere microflora
7. Measurement of microorganisms
8. Preparation of culture media
9. Isolation and purification of rhizospheric microbes
10. Isolation and purification of Endophytes.
11. Morphological Characteristics of plants used in phytoremediaton of polluted soil, water & air
12. Selection of suitable agronomic plants in phytoremediation of heavy metal polluted soils
13. Selection of suitable ornamental plants for phytoremediation of polluted air
14. Identification of efficient plant part in accumulation of heavy metals through estimation of plant biomass
15. Identification of growth responses of ornamental plants under organic contaminant stress
16. Visit to Phytoremediation adopted sites/places

References:

1. Pelczar, M.J., Chan, E.C.S. &Kreig, N.R. (2002) Microbiology. 5th Edition, Tata McGraw-Hill, New Delhi.
2. Rangaswami, G. &Bagyaraj, D. J. (2005) Agricultural Microbiology. Prentice-Hall of India Pvt. Ltd., New Delhi.
3. Mukherjee, N. & Ghosh, T. (2004). Agricultural Microbiology. Kalyani Publishers, Calcutta
4. Dubey, H.C. (2007). A Textbook of Fungi, Bacteria and Viruses. Vikas Publishing House Ltd.,New Delhi – 10014
5. Salyers, A. A., & Whitt, D. D. (2001). Microbiology: diversity, disease, and the environment.Fitzgerald Science Press, Inc.
6. Prescott, L. M. (2002). Microbiology 5th Edition. McGraw-Hill Inc.,US
AbdElgawad H., Zinta G., Abuelsoud W., Hassan Y. M., Alkhalifah D. H. M., Hozzein W. N., et al.. (2021). An actinomycete strain of nocardiopsislucentensis reduces arsenic toxicity in barley and maize. *J. Hazardous Materials* 417, 126055. doi: 10.1016/j.jhazmat.2021.126055 [PubMed] [CrossRef] [Google Scholar]
7. Azhar U., Ahmad H., Shafqat H., Babar M., Munir H. M. S., Sagir M., et al..
(2022). Remediation techniques for elimination of heavy metal pollutants from soil: A review. *Environ. Res.* 113918. doi: 10.1016/j.envres.2022.113918 [PubMed] [CrossRef] [Google Scholar]
8. Chaudhary K., Agarwal S., Khan S. (2018). "Role of phytochelatins (PCs), metallothioneins
(MTs), and heavy metal ATPase (HMA) genes in heavy metal tolerance," in *Mycoremediation and environmental sustainability* (Cham: Springer;), 39–60. doi: 10.1007/978-3-319-77386-5_2 [CrossRef] [Google Scholar]
9. Mackova, Martina, Dowling, David, Macek, Tomas (2006) Phytoremediation and Rhizoremediation. Springer.
10. OroojSurriya, S.S.S., Waqar, K. and Kazi, A.G., 2014. Phytoremediation of soils: prospects
and challenges. Soil remediation and plants: Prospects and challenges, p.1.
11. Sarma, H., 2011. Metal hyperaccumulation in plants: a review focusing on phytoremediation
technology. Journal of Environmental Science and Technology, 4(2), pp.118-138.
12. Tsao, D. T. (2003) Phytoremediation: Advances in Biochemical Engineering Biotechnology.
151 Edition, Springer. 2003
13. Todd A. A. (1994) Bioremediation through Rhizosphere Technology 15th edition, An American Chemical Society Publication.

Course No.: GPEL-4.8.2

Course Title: Biotechnology and Micropropagation for Crop Improvement-3 (2+1)

Lecture Outline

Theory

1. Introduction, history and basic Principles of Biotechnology, Impact of Biotechnology on crop improvement and perspective of society and various biotechnological techniques

2. Micro-propagation methods; organogenesis and embryogenesis, plant tissue, cell, organ culture,

3. In vitro culture and hardening; callus culture types, Protoplast isolation, culture and regeneration

4. Somatic hybridization (somatic hybrids & cybrids) and its application in crop improvement

5. Somaclonal variation and its use in crop improvement; embryo culture and endosperm culture

6. In vitro mutation and in vitro selection for biotic and abiotic stresses

7. Plant transformation methods – Agrobacterium mediated plant transformation, co-integrate and binary vector system

8.&9. Direct gene transfer methods – biolistic gun, microinjection and electroporation. Chloroplast transformation. Transgene design-Promoters & Marker genes.

10. Applications of transgenic plants

11. Biosafety regulations and regulatory mechanism of transgenic crops

12. Gene silencing techniques; introduction to siRNA; siRNA technology;

13&14. Micro RNA; construction of siRNA vectors; principle and application of gene silencing; creation of transgenic plants

15 &16. Introduction to genome editing – Various tools of genome editing; CRISPR-Cas9 with specific emphasis on Indian regulations; Cloning genomic targets into CRISPR/Cas9 plasmids; Applications of CRISPR/cas9 technology in crop plants.

17, 18 & 19. Marker Assisted Breeding & Genomic Selection: Introduction to various DNA-based markers and their use in marker-assisted breeding; Foreground Selection, Recombinant Selection and background Selection

20. Marker-assisted backcross breeding for introgression of genes and QTLs

21&22. Gene/QTL pyramiding strategies; MARS (Marker Assisted Recurrent Selection – success stories

23 &24. Introduction to Genomic Selection. Introduction to genome mapping-Construction of genetic linkage maps.

25 & 26. Linkage mapping software packages; GWAS (Genome Wide Association Studies); Navigating from genetic to physical map.

27 &28. Targeting Induced Local Lesions in Genomes (TILLING), ECOTILLING and its application in crop breeding,

29. Allele mining, Comparative/Synteny mapping.

30. Advances in SSR genotyping – capillary system and chip based;

31 & 32. SNP genotyping – Illumina's Golden Gate Technology.

Practical

1. Study of components of tissue culture laboratory and preparation of stock solutions for medium preparation
2. Preparation of nutrient media
3. Callus culture in medicinal plant
4. , 5 & 6. Mass multiplication of chrysanthemum and Gerbera
7. Micro propagation in Banana
8. Anther culture
9. Embryo culture
10. & 11. In vitro screening for abiotic stress tolerance in fruits and vegetables
12. Restriction digestion of bacterial DNA
13. & 14. Isolation of genomic DNA and Agarose gel electrophoresis

15. & 16. PCR with RAPD and SSR markers

References:

- Introduction to plant tissue culture by M.K.Razdan, Science publishers, Inc.
- Gene cloning: An Introduction by Terence A Brown, Stanley Thornes publishers
- Plant Biotechnology: the genetic manipulation of the plants by Adrial Slater, Nigel W.
- Scott and Mark R Fowler. Oxford publishers
- Marker assisted plant breeding: principles and practices by B.D. Singh and A.K.Singh,
- Springer publishers
- CRISPR Gene Editing: Methods and Protocols by Yonglun Luo, Springer publishers

Course No.:ESEL-4.11.1

Course Name: Agricultural Finance and Co-operation-2 (1+1)

Lecture Outlines

Theory

1. Agricultural Finance- meaning, scope and significance, credit needs and its role in Indian agriculture. Recent developments in agricultural credit.
2. Agricultural credit - definition, principles and classification
3. Sources of agricultural finance in India: Institutional and non-institutional sources
4. Commercial banks, nationalization of commercial banks, micro finance –Lead bank scheme & Regional Rural Banks (RRBs), Single window system
5. An introduction to higher financing institutions – Reserve Bank of India (RBI) and National Bank for Agricultural and Rural Development (NABARD)
6. World Bank, International Monetary Fund (IMF), Asian Development Bank (ADB) and Credit Guarantee Corporation of India.
7. Credit analysis: 3 R's, and 5 C's and 7 P's of farm credits
8. Crop Loan System: Objectives- Importance- Procedural formalities of banks in sanctioning of loans.
9. Scale of Finance-its estimation. Term Loans and Interest Rates, Kisan Credit Card - origin, objectives and features
10. Repayment Plans – meaning and types of repayment plans
11. Financial statements – Balance Sheet, Income Statement and cash flow statements
12. Preparation of bankable project reports- Bank norms
13. Agricultural Cooperation in India– Meaning & significance, brief history of cooperative development in India- Objectives, principles of cooperation
14. Cooperative credit structure in India- credit, marketing, consumer and multipurpose Cooperatives, farmers' service cooperative societies etc.
15. Role of International Co-operative Alliance (ICA), National Co-operative Union of India
    (NCUI), National Co-operative Development Corporation (NCDC) and National Agricultural Co-operative Marketing Federation of India (NAFED)

16. Crop insurance: its scope, significance and limitations -NAIS-Pradhan Mantri Fasal Bima Yojana'

Practical

1. Estimation of credit requirement of farm business
2. Visit to a commercial bank
3. Visit to a Cooperative bank
4. Study of RRBs / SHGs
5. Working out various repayment plans
6. Methods and Mechanics of Processing Loan Application of the farmers
7. Estimation of Scale of Finance
8. Preparation and analysis of balance sheet.
9. Preparation and analysis of income statement.
10. Preparation and analysis of cash flow statement
11. Techno- economic parameters for preparation of projects.
12. Preparation of Bankable projects for various agricultural/horticultural commodities
13. Visit to a Cooperative Society
14. Study of successful Farmer Producer Organizations
15. Seminar on selected topics
16. Seminar on selected topics

References

- Reddy, S. S. and Ram, P.R. 1996. Agricultural Finance and Management. Oxford & IBH
- Vishnu Shankar Meena, Shirish Sharma, Sweta Singh. 2022. A Text Book of Agricultural Finance And Cooperation. S.R. Scientific Publication
- S. Subba Reddy, P. Raghu Ram, T.V. Neelakanta Sastry and I.Bhavani Devi. 2018.
- Agricultural Economics. Second Edition, Oxford & IBH Publising Co. Pvt. Ltd, New Delhi
- U. K. Pandey. 1990. An introduction to Agricultural Finance. Kalyani Publishers, New Delhi

VIII SEMESTER COURSES-Student READY(RHWEP+ELP)

Student READY (Rural Entrepreneurship Awareness Development Yojana) programme is a new initiative of Indian Council of Agricultural Research to reorient graduates of Horticulture and allied subjects for ensuring and assuring employability and develop entrepreneurs for emerging knowledge intensive agriculture.Actually this programme includes five components i.e. Experiential Learning, Rural Awareness Works Experience, In-Plant Training / Industrial attachment, Hands-on training (HOT) / Skill development training and Students Projects. The ICAR has recommended to opt any two of the components of student READY.Dr.YSR Horticultural university is offering RHWEP &ELP for final year students in the final semester.Asthe Rural Horticulture Work Experience Programme (RHWEP)helps the students primarily to

understand the rural situations, status of technologies adopted by farmers, prioritize the farmers problems and to develop skills and attitude of working with farm families for overall development in rural area where as Experiential learning(EL) provides the students an excellent opportunity to develop analytical and entrepreneurial skills and knowledge through meaningful hands on experience, confidence in their ability to design and execute project work. The details of the programme being implemented at Dr.YSRHU
are as given below

S. No.	Course title	Credits
Student READY-20 Credits		
I	RHWEP	10
a.	Crop production	5
b.	Plant protection	2
c.	Rural economics	1
d.	Extension programme	1
e.	Research station Activities	1
II	ELP	10

ELP Modules offered by Dr.YSRHU at all colleges

S.No	Course No.	Title of the Course / Modules	Credit Hours
1	(ELP-401)	Commercial Horticulture	10(0+10)
2	(ELP-402)	Protective Cultivation of High Value Horticulture Crops	10(0+10)
3	(ELP-403)	Processing of Fruits and Vegetables for Value Addition	10(0+10)
4	(ELP-404)	Floriculture and Landscape Architecture	10(0+10)
5	(ELP-405)	Bio-inputs: Bio-fertilizers and Bio-pesticides	10(0+10)
6	(ELP-406)	Mass Multiplication of Plant And Molecules through Tissue Culture	10(0+10)
7	(ELP-407)	Mushroom culture	10(0+10)
8	(ELP-408)	Bee keeping	10(0+10)
9.	(ELP-409)	Vermicomposting	10(0+10)
10	(ELP-410)	Organic Production Technology	10(0+10)
11	(ELP-411)	Dehydration of fruits and vegetables for value addition	10(0+10)

Massive Open Online Courses (MOOCs)

Semester	Credits
V	2
VI	2
VII	3
VIII	3

MOOC3.0.1	2	MOOCs	10(0+10)	V semester
MOOC3.0.2	2	MOOCs		VI semester
MOOC4.0.1	3	MOOCs		VII semester
MOOC4.0.2	3	MOOCs		VIII semester