

Course No.: H/ ENTO-121

Title: Fundamentals of Entomology

Credits: (2+1) 3

Semester: II

Theory:

Introduction and History of Entomology in India including contribution of scientists in brief.

Definitions: Insect, Entomology, Horticultural Entomology. Classification of phylum Arthropoda up to classes. Relationship of class Insecta with other classes of Arthropoda. Insect Dominance.

Economic importance of insects: Harmful, Beneficial and productive insects. Premier institutes concerned with Entomology. Insect Integument: Structure and Functions. Cuticular appendages and processes.

Moulting: Definition and steps in moulting. Body segmentation: Structure of head, thorax and abdomen.

Insect Head Capsule: Important sclerites and sutures. Positions of head. Structure and

modifications (with examples) of insect antennae, mouth parts, legs and wings (wing venation, wing

coupling apparatus with examples). Structure of thorax and abdomen: segmentation, appendages and

processes, pregenital and post genital appendages and structure of male and female genital

organ. Metamorphosis: Definition and Types of metamorphosis with examples. Post embryonic

development: Eclosion. Insect egg: General structure, Types of egg with examples (at least one).

Types of larva and pupa with examples. Structure and functions of digestive, nervous, circulatory,

respiratory, excretory, secretory and reproductive system in insects. Types of reproduction in

insects. Sensory and Sound producing organs.

Systematics: Definitions: Taxonomy, Systematics, Binomial nomenclature, Order, Family, Genus,

Species, Subspecies, Biotype. Binomial nomenclature: Definition and Rules. Classification of Class

Insecta upto Orders. Important orders: Important distinguishing/taxonomic characters of orders.

Families of horticultural importance with examples. Orthoptera: Acrididae, Tettigonidae, Gryllidae,

Gryllotalpidae; Dictyoptera: Mantidae, Blattidae; Odonata; Isoptera: Termitidae; Thysanoptera:

Thripidae; Hemiptera: Pentatomidae, Coreidae, Cimicidae, Pyrrhocoridae, Lygaeidae, Cicadellidae,

Delphacidae, Aphididae, Coccidae, Aleurodidae, Pseudococcidae, Lophopidae, Lacciferidae;

Neuroptera: Chrysopidae; Lepidoptera: Pieridae, Papilionidae, Noctuidae, Sphingidae, Pyralidae,

Gelechiidae, Arctiidae, Saturniidae, Bombycidae; Coleoptera: Coccinellidae, Chrysomelidae,

Cerambycidae, Curculionidae, Bruchidae, Scarabaeidae; Hymenoptera: Tenthredinidae, Apidae.

Trichogrammatidae, Ichneumonidae, Braconidae, Chalcididae; Diptera: Cecidomyiidae, Tachinidae, Agromyziidae, Culicidae, Muscidae, Tephritidae.

Plant mites: Morphological/general features of phytophagous mites, important families with examples (Tetranychidae, Tarsonomidae, Tenuipalpidae and Eriophyidae).

Practical:

Methods of collection and preservation of insects including immature stages. Identification of important insect. External features of Cockroach/Grasshopper. Study of Types of insect antennae, mouthparts (dissection) and legs. Wing venation, types of wings and wing coupling apparatus. Types of insect larvae and pupae. Study and Dissection of digestive system in insects (Cockroach (caterpillar) /Grasshopper). Study and Dissection of Central nervous system in insects (Cockroach/Grasshopper). Study and Dissection of male and female reproductive systems in insects (Cockroach/Grasshopper). Study of distinguishing/taxonomic characters of orders: Orthoptera, Dictyoptera, Odonata, Isoptera, Thysanoptera, Hemiptera, Lepidoptera, Neuroptera, Coleoptera, Hymenoptera, Diptera. Families of horticultural importance with examples.

Teaching Schedule: Theory -

Lecture No.	Topic	Weightage (%)
1-3	<ul style="list-style-type: none"> ➤ Introduction and History of Entomology in India including contribution of scientists in brief. Definitions: Insect, Entomology, Horticultural Entomology. ➤ Classification of phylum Arthropoda up to classes. ➤ Relationship of class Insecta with other classes of Arthropoda. ➤ Insect Dominance. ➤ Economic importance of insects: Harmful, Beneficial and productive insects. ➤ Premier institutes concerned with Entomology. 	10
4-5	<ul style="list-style-type: none"> ➤ Insect Integument: Structure and Functions. Cuticular appendages and processes. Moulting: Definition and steps in moulting. ➤ Body segmentation: Structure of head, thorax and abdomen. 	10
6-10	<ul style="list-style-type: none"> ➤ Insect Head Capsule: Important sclerites and sutures. Positions of 	10

	<p>head.</p> <ul style="list-style-type: none"> ➤ Structure and modifications (with examples) of insect antennae, mouth parts, legs and wings (wing venation, wing coupling apparatus with examples). ➤ Structure of thorax and abdomen: segmentation, appendages and processes, pregenital and post genital appendages and structure of male and female genital organ. 	
11-13	<ul style="list-style-type: none"> ➤ Metamorphosis: Definition and Types of metamorphosis with examples. ➤ Insect egg: General structure, Types of egg with examples (at least one) ➤ Types of larva and pupa with examples. ➤ Sensory and Sound producing organs: Location and functions: mechanoreceptors, audio receptors, chemoreceptors, thermo and humidity receptors, photoreceptors and organs of visions with examples. 	10
14-22	<ul style="list-style-type: none"> ➤ Structure and functions of digestive, nervous, circulatory, respiratory, excretory, secretary and reproductive system in insects. Types of reproduction in insects. Post embryonic development: eclosion. 	20
23-24	<p>Systematics:</p> <ul style="list-style-type: none"> ➤ Definitions: Taxonomy, Systematics, Binomial nomenclature, Order, Family, Genus, Species, Subspecies, Biotype. Binomial nomenclature: Definition and Rules. ➤ Classification of Class Insecta up to Orders. 	05
25-27	<ul style="list-style-type: none"> ➤ Study of important orders of insects: Important distinguishing/taxonomic characters of orders. Families of horticultural importance with examples. Orthoptera: Acrididae, Tettigonidae, Gryllidae, Gryllotalpidae; Dictyoptera: Mantidae, Blattidae; Odonata; Isoptera: Termitidae; Thysanoptera: Thripidae. 	10
28-29	<ul style="list-style-type: none"> ➤ Hemiptera: Pentatomidae, Coreidae, Cimicidae, Pyrrhocoridae, Lygaeidae, Cicadellidae, Delphacidae, Aphididae, Coccidae, Aleurodidae, Pseudococcidae, Lophopidae, Lacciferidae; Neuroptera: Chrysopidae; Lepidoptera: Pieridae, Papilionidae, Noctuidae, Sphingidae, Pyralidae, Gelechiidae, Arctiidae, Saturniidae, Bombycidae. 	10

30-31	➤ Coleoptera: Coccinellidae, Chrysomelidae, Cerambycidae, Curculionidae, Bruchidae, Scarabaeidae; Hymenoptera: Tenthredinidae, Apidae, Braconidae, Trichogrammatidae, Ichneumonidae, Chalcididae; Diptera: Cecidomyiidae, Tachinidae, Agromyziidae, Culicidae, Muscidae, Tephritidae.	10
32	➤ Plant mites: Morphological/general features of phytophagous mites, important families with examples (Tetranychidae, Tarsonomidae, Tenuipalpidae and Eriophyidae).	05
	Total	100

Teaching Schedule: Practical -

Ex. No	Name of the experiment
1.	Methods of collection and preservation of insects including immature stages
2.	External features of typical insect (eg. Cockroach/ Grasshopper) structure of head, thorax and abdomen/General body organisation of insect
3.	Structure of antennae and its modifications along with examples. Structure of typical leg and modifications of legs.
4.	Study and Dissection of chewing and biting type of mouthparts.
5.	Study and Dissection of Chewing and lapping type of mouthparts.
6.	Study and Dissection of piercing and sucking type of mouthparts.
7.	Study and Dissection of sponging type of mouthparts.
8.	Study of insect wings: Structure, Wing Venation, types of wings and wing coupling apparatus along with examples.
9.	Types of larvae and pupae.
10.	Study and Dissection of digestive system of Cockroach / Grasshopper.
11.	Study and Dissection of male reproductive system of Cockroach / Grasshopper. Study and Dissection of female reproductive system of cockroach / Grasshopper.
12.	Study and Dissection of central nervous system of Cockroach / Grasshopper.
13.	Study of distinguishing/taxonomic characters of orders viz., Odonata, Orthoptera, Dictyoptera. Families of Horticultural importance from these orders with examples.
14.	Study of distinguishing/taxonomic characters of orders viz., Isoptera, Thysanoptera and Hemiptera. Families of Horticultural importance from these orders with examples.
15.	Study of distinguishing/taxonomic characters of orders viz., Neuroptera, Lepidoptera and Hymenoptera. Families of Horticultural importance from these orders with examples..
16.	Study of distinguishing/taxonomic characters of orders viz., Diptera and Coleoptera.

Families of Horticultural importance from these orders with examples..
--

Textbooks:

Richards O.W. and R.G. Davies – Imms' General Text Book of Entomology –Vol. I and II

Reference Books:

Chapman, R. F. – The Insects : Structure and Functions

David, B. V. and T. Kumarswami – Elements of Economic Entomology Marc J. Klowden- Physiological systems in Insects

Pant N.C. and Swaraj Ghai – Insect Physiology and Anatomy

Nayar, K. K.; Anathkrishanan T.N. and B.V.David – General and Applied Entomology Patton R.L.- Introductory Insects Physiology

Wigglesworth – Principles of Insects Physiology

Metcalf and Flint – Destructive and Useful Insects; their habits and control. Evan G.O -Principles of Acarology.

Krantz G.W – A manual of Acarology.

e-reading: <http://ecourses.iasri.res.in/>

Course NO. H/ENTO-365

Course title : Nematode Pests of Horticultural Crops and their management

Credits : 1 + 1 = 2

Semester : VI

Theory:

History of development of Nematology-Definition, economic importance. General characteristics of plant parasitic nematodes. Nematode general morphology, taxonomy and biology. Classification of nematodes. Symptomatology. Control of important plant parasitic nematodes of Fruit crops: Pomegranate, Grapes, Fig, Citrus, Strawberry, Cashewnut, Vegetable crops: Tomato, Brinjal, Okra, Chilli and Cucurbits etc. Tuber and bulb crops: Potato, Sweet potato, Carrot, Radish and onion; Ornamental crops: Chrysanthemum, Rose, Tuberose, Gladiolus, Carnation and Gerbera; Spices: Turmeric, Ginger, Cardamom and Clove; Plantation Crops: Banana, Area nut and Coconut.

Practical:

Methods of sampling.Extraction of nematodes from soil and plant parts.Counting and estimation of plant parasitic nematodes. Nematode killing, fixing and preparation of temporary and permanent mounts. Nematicides and their use. Collection and preservation of 20 plant species/parts damaged by plant parasitic nematodes.

Lesson plan : Theory

Lecture No.	Topic	Weightage (%)
1	History of development of Nematology-Definition, economic importance.	10
2	General characteristics of plant parasitic nematodes.	5
3-4	Nematode general morphology and biology.	5
5-6	Classification of nematodes : (up to major order and families)	10
7	Classification based on habitats Symptomatology: Above and below ground	10
8-9	Control of important plant parasitic nematodes of fruit crops: Pomegranate, Grapes, Fig, Citrus, Strawberry, Cashew nut.	10
10	Vegetable crops: Tomato, Brinjal, Okra, Chilli and Cucurbits etc.	10
11	Tuber and bulb crops: Potato, Sweet potato, Carrot, Radish and Onion.	10
12	Ornamental crops : Chrysanthemum, Rose, Tuberose, Gladiolus, Carnation and Gerbera.	5
13	Spices : Turmeric, Ginger, Black pepper Cardamom and Clove	5
14	Plantation crops: Banana, Areca nut and Coconut.	10
15	Role of nematodes in plant disease complex.	5
16	Integrated nematode management.	5
	Total	100

Lesson plan : Practical

Sr. No.	Particulars
1.	Procedure for collection of soil and root samples
2.	Extraction of nematodes from soil samples
3.	Extraction of nematodes from plant material
4.	Counting and picking of nematodes

	Preparation of temporary and permanent mounts of nematodes
5.	Gross morphology of plant parasitic nematodes
6.	Taxonomic classification of plant parasitic nematodes of horticultural importance
7.	Below and above ground symptoms produced by nematodes with examples
8.	Interaction between plant parasitic nematodes with disease causing fungi, bacteria, viruses etc.
9	Important nematode pests of horticultural (fruit) crops- Root Knot Nematode <i>Meloidogyne</i> spp, Reni form Nematode- <i>Rotylenchulus Reniformis</i> , Root Lesion Nematode- <i>Pratylenchus</i> spp, Spiral Nematode- <i>Helicotylenchus</i> spp, Cyst Nematodes- <i>Heterodera</i> and <i>Globodera</i> , Dagger Nematode- <i>Xiphenema</i> spp, Citrus Nematode- <i>Tylenchulus semipenetrans</i> , Burrowing Nematode- <i>Radopholus similis</i> .
10	Important nematode pests of plantation crops- Root Knot Nematode <i>Meloidogyne</i> spp, Reni form Nematode- <i>Rotylenchulus Reniformis</i> , Root Lesion Nematode- <i>Pratylenchus</i> spp, Spiral Nematode- <i>Helicotylenchus</i> spp, Cyst Nematodes- <i>Heterodera</i> and <i>Globodera</i> , Dagger Nematode- <i>Xiphenema</i> spp, Citrus Nematode- <i>Tylenchulus semipenetrans</i> , Burrowing Nematode- <i>Radopholus similis</i> .
11	Important nematode pests of vegetable crops- Root Knot Nematode <i>Meloidogyne</i> spp, Reni form Nematode- <i>Rotylenchulus Reniformis</i> , Root Lesion Nematode- <i>Pratylenchus</i> spp, Spiral Nematode- <i>Helicotylenchus</i> spp, Cyst Nematodes- <i>Heterodera</i> and <i>Globodera</i> , Dagger Nematode- <i>Xiphenema</i> spp, Citrus Nematode- <i>Tylenchulus semipenetrans</i> , Burrowing Nematode- <i>Radopholus similis</i> .
12	Integrated nematode management methods – Cultural (Crop rotation, Fallowing, Soil amendments, Other land management techniques, Resistant varieties etc.),
13	Integrated nematode management methods –Physical (Soil solarization, Sterilization, Hot water treatment, Fumigation), Biological, Chemical, Legislative methods,
14	Nematicides and their use
15.	Collection and preservation of 20 plant species/parts damaged by Plant parasitic nematodes.
16	Collection and preservation of 20 plant species/parts damaged by Plant parasitic nematodes.

No.	Name of book	Name of the author and publication
Text books:		
1.	A Textbook of Plant Nematology	Upadhyay K.D. and Dwivedi K. 1997, Amman Publishing House, Meerut.
References books:		
1.	Plant nematode control	Whitehead A.G., CAB International Wallingford U.K.
2.	Nematode pest management	Swarup G. Deogupta D.R. and Gill J.S.
3.	An appraisal of Eco-Friendly Approaches	Nematological Society of India IARI, New Delhi
4.	A Treatise on phytonematology	P. Parvatha Reddy Agri. Cole Publishing Academy New Delhi

Course No.: H/ENTO-243

Course Title: Insect Pests of Fruit, Plantation,
Medicinal and Aromatic Crops

Credits: (2+1) 3

Semester: IV

Syllabus (Theory):

General – economic classification of insects. Ecology and insect-pest management with reference to fruit, plantation, medicinal and aromatic crops. Pest survey, surveillance & forecasting. Distribution, host range, bio-ecology, injury, integrated management of important insect pests affecting tropical, sub-tropical and temperate fruits, plantation, medicinal and aromatic crops like citrus, mango, grapevine, pomegranate, guava, fig, banana, papaya, custard apple, ber, sapota, jamun, aonla, jackfruit, coconut, areca nut, oil palm, cashew, cacao, tea, coffee, rubber, betelvine, apple, pear, peach, plum, almond, cinchona, senna, neem, hemp, belladonna, pyrethrum, isabgol, dhatu, wildbrinjal, sweetflag, safedmusli, shatavari, ashwangandha, sarpgandha, opium, tephrosia, mint, dioscoria, comphor, costus, crotalaria, jasmine, patchouli, vetiver, davana, kevara, citronella, geranium, lemongrass, palmarose, eucalyptus and sandalwood . Storage insects – distribution, host range, bio-ecology, injury. Integrated management of important insect pests attacking stored fruits, plantation, medicinal and aromatic crops and their processed products. Insecticide residue problems in fruit, plantation, medicinal and aromatic crops and their maximum residual limits (MRLs).

Syllabus (Practical):

Study of symptoms of damage, collection, identification, preservation, assessment of damage and population of important insect – pests affecting citrus, mango, grapevine pomegranate, guava, fig, banana, papaya, custard apple, ber, sapota, jamun, aonla, jackfruit, coconut, areca nut, oil palm, cashew, cacao, tea, coffee, rubber, betel vine, apple, pear, peach, plum, almond, cinchona, senna, neem, hemp, belladonna, pyrethrum, isabgol, dhatu, wild brinjal, sweet flag, safedmusli, shatavari, ashwangandha, sarpgandha, opium, tephrosia, mint, dioscoria, comphor, costus, crotalaria, jasmine, patchouli, vetiver, davana, kevara, citronella, geranium, lemongrass, palmarose, eucalyptus and sandalwood. Study of symptoms of damage, collection, identification, preservation, assessment of damage and population of pests of stored fruits, plantation, medicinal and aromatic plants.

Teaching Schedule & Lesion Plan (Theory):

Lecture No.	Topic	Weightage (%)
1 & 2	General and economic classification of insects; definition of pest, ETL, EIL, pest management, category of pest, harmful and beneficial insects.	10
3.	Ecology, scope, importance, its types, components of environment and insect-pest management with reference to fruit, plantation, medicinal and aromatic crops. Pest survey, surveillance, forecasting and its importance in IPM.	
Fruit crops: Distribution, host range, bio-ecology, injury, integrated management of important insect pests affecting		
4.	Citrus: Major pests; Fruit sucking moth, lemon butterfly, leaf Minor, citrus psylla, whitefly and black fly, bark eating caterpillar. Minor pests; Nematodes, mealy bug, aphid, scale.	

5. **Mango:** Major pests; Hoppers/Jassids, fruit fly, stone weevil, stem

	borer, mealy bug, bark eating caterpillar, thrips, leaf gall, midge fly. Minor pests; Red ants, shoot borer, scale insects, slug caterpillar.	45	
6.	Grapevine: Major pests; Flea beetle, thrips, mealy bug, mites. Minor pests; Stem girdler, cockchafer beetle.		
7.	Pomegranate: Major pests; Fruit borer, mealy bug, thrips, scale insects, white fly, bark borer. Minor pests; Fruit sucking moth, mites, shot hole borer, aphid.		
8.	Guava: Major pests; Fruit fly, spiraling white fly, bark eating caterpillar, fruit borer. Minor pests; Scale insects, mealy bug. Fig: Major pests; Jassids, scale insects, mealy bug. Minor pests; Mite, stem borer.		
9.	Banana: Major pests; Root stock weevil, thrips, tinged bug, leaf eating caterpillar, pseudostem borer, aphid. Minor pests; Burrowing nematodes. Papaya: Mealy bug, white fly, green peach aphid, ash weevil. Custard apple: Mealy bug.		
10.	Ber: Major pests; Ber fruit borer, ber fruit fly. Minor pests; Hairy caterpillar, jassids.		
11.	Sapota: Major pests; Chiku moth, seed borer, bud borer, fruit fly, stem borer, hairy caterpillar. Minor pests; Mealy bug, green scale, leaf folder. Jamun: Ash weevil, fruit fly, sphinx moth, white fly, leaf eating caterpillar.		
12.	Aonla: Major pests; Shoot gall maker, bark borer, fruit borer. Minor pests; Mealy bug, aphids, leaf eating caterpillar. Jackfruit: Shoot and fruit borer, bud weevil/leaf eating weevil, leaf Webber, mealy bug, scale, spittle bug.		
Plantation crops: Distribution, host range, bio-ecology, injury, integrated management of important insect pests affecting			
13& 14	Cashew nut: Major pests; Stem and root borer, tea mosquito bug, apple and nut borer, thrips Minor pests; Leaf Minor, leaf and blossom Webber, leaf beetle/red beetle. Cacao: Stem borer, Mealy bug, black aphids, cow bug.		10
15.	Coconut and Oil Palm: Major pests; Rhinoceros beetle, red palm weevil, black headed caterpillar, eriophyide mite, rodent. Minor pests; Termite, scale insects, Mealy bug. Arecanut: Spindle bug, root grub, inflorescence caterpillar, mites		
16&17	Tea: Major pests; Tea mosquito bug, jassids, pink/orange mite, red spider mite, bunchy caterpillar, tea borer, hepialid borer. Minor pests; Shot hole borer, nematodes, thrips Coffee: Major pests; coffee berry borer, red borer, white borer. Minor pests; Root lesion nematode, cockchopper beetle, coffee scale,		

	snail.	
18.	Betelvine: Betelvine bugs, scale insects, white fly, Mealy bug, white grub. Rubber: Rubber bark eating caterpillar, scale insects, ash weevils, Mealy bug.	
19.	Study of pests of Temperate Fruit crops (Apple, Pear, Peach and Plum): Major pests; Peach leaf curl aphid, apple wooly aphids, san jose scale, apple codling moth, apple tent caterpillar. Minor pests; blossom thrips, plum weevil, plum fruit moth, mites. Almond: Almond weevil, almond moth, tent caterpillar, brown mite, tree borer, stink bug, leaf roller	05
Medicinal crops: Nature of damage & control measures of pests affecting		
20.	Cinchona: Scale insects, mirid bug. Senna: Leaf eating caterpillar, White butterfly, pod borer. Neem: Tea mosquito bug, thrips, semilooper. Hemp: Hemp flea, hemp borer, green fly, European corn borer. Belladonna: Leaf defoliator. Pyrethrum: Nematodes, thrips, aphids, red spider mites.	
21.	Isabgul: White grub, red cotton bug, cutworm. Datura: Thrips, leaf bug, white flies, aphid. Costus: Grasshopper, thorn bug, hairy caterpillar, ash weevil. Crotalaria: Sunnhemp moth, stem borer, top shoot borer, flea beetle. Wild brinjal: Brinjal shoot and fruit borer, brinjal stem borer. Sweet flag: Shoot and root Mealy bugs. Safedmusli: White grub, leaf eating caterpillar.	10
22.	Shatavari : Asparagus beetle. Ashwagandha/sarpagandha: Epilachna beetle, Mealy bugs, sphingid caterpillar. Opium: Root weevil, cutworm, capsule borer. Tephrosia: Mealy bug, seed borer, cutworm, tea mosquito bug. Mint: Leaf roller, hairy caterpillar, root borer. Dioscorea: Aphids, red spider mite, cutworm.	
Aromatic crops: Nature of damage & control measures of pests affecting		
23.	Camphor: Scale insects. Patchouli: Leaf Webber/leaf eating caterpillar, mirid bug, root knot nematode.	
24.	Jasmine: Leaf webworm, budworm, aphid, thrips, two spotted spider mite.	
25.	Vetiver: Stem borer, root infecting beetle, nematodes. Davana: Davana bug, semilooper. Kevara: Leaf hopper.	10
26.	Citronella: Shoot borer, grasshopper, armyworm, eriodphyid mite. Geranium: Root knot nematodes, termite, cutworm. Lemon grass: Shoot borer, spittle bug. Palmarose: Thrips, white grub.	
27.	Eucalyptus: Termites shoot borer. Sandalwood: Leaf Webber, long horned grasshopper, leaf hopper, thrips, red borer.	

Stored pests: Distribution, host range, bio-ecology, injury	
28&29	Major pests: Indian meal moth, Fig and almond moth, rust red flour beetle, khapra beetle, raisin moth, dried fruit beetle. 05 Minor pests: Saw toothed grain beetle, rice moth.
30.	Preventive and curative measures for pest management of stored fruits, plantation, medicinal and aromatic plants.
Pesticides residues	
31&32	Definition of pesticides residues, acceptable daily intake, maximum residual limits, toxicity, its types, LC50, LD50, LT50, GAP, list of 05 instrument for detection of pesticide residues and maximum residual limits of pesticides in export fruits, plantation, medicinal and aromatic commodities.

Practical Schedule:

Ex. No.	Title of Exercise
1.	Study of symptoms of damage, collection, identification, preservation, assessment of damage and population of pests of citrus
2.	Study of Pests of Mango
3.	Study of Pests of Grapevine
4.	Study of Pests of Pomegranate, Aonla Study of Pests of Guava, Fig and Jackfruit
5.	Study of Pests of Banana, Papaya and Custard apple
6.	Study of Pests of Ber , Sapota and Jamun
7.	Study of Pests of Cashew, Cacao, Tea and Coffee
8.	Study of Pests of Coconut, Areca nut and Oil Palm.
9.	Study of Pests of Temperate Fruit crops (Apple, Pear, Peach, Plum, almond)
10.	Study of Pests of Betel vine and Rubber
11.	Study of Pests of Cinchona, senna, neem, hemp & belladonna
12.	Study of Pests of Pyrethrum, Isabgoal, Dhatura, Costus & Crotalaria
13.	Study of Pests of Wild brinjal, Sweet flag, Safedmusli, Shatavari, Ashwagandha, Opium
14.	Study of Pests of Tephrosia, Mint, Dioscoria, Comphor, & Jasmine
15.	Study of Pests of Patchouli, Vetiver, Davana, Kevara & Citronella Study of Pests of Geranium, Lemongrass, Palmarose, Eucalyptus & Sandalwood
16.	Study of pests of stored fruits, plantation, medicinal and aromatic plants

Textbooks:

David B V and Kumarswami, T, 1982. Elements of Economic Entomology. Popular Book Department, Madras, 536p.

Ramnivas Sharma : Identification and management of horticulture pest.

Reference Books:

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.

Nair M R G K, 1995, Insect and Mites of Crops in India, ICAR, New Delhi.

Ayyar, T.V.R. 1963. Hand book of entomology for south India. Govt. press Madras, 516p.

David. V. Alford. Pest of fruit crops. A. M. Ranjith. Identification and management of Horticultural pest.

Rachna and Bennakumari. Pest management and residual analysis in horticultural crop K. P. Srivastav and Y. S. Ahawat. Pest management in citrus.

Fryer : Insect pest of fruit crops

S. Atwal. Agricultural pests of south Asia and their management.

Mark Vernon Slinger land and C. R. Crosby. Manual of fruit insects.

Metcalf, R.Land Luckman,W.H.1982. Introduction to Insect pest management. WileyInterSciencePublishing,NewYork

Butani, D.K.1984. Insects and Fruits. Periodical Expert Book Agency, NewDelhi

e-reading: <http://ecourses.iasri.res.in/>

Course No: H/ENTO- 354

Course Title: Apiculture, Sericulture and Lac Culture

Credits: (1+1) 2

Semester: V

Theory

Introduction to beneficial insects. Importance and History of apiculture. Species of honey bees, Rock bee, Little bee, Indian bee, European bee, Italian bee and Dammar bee, lifecycle and caste determination. Bee colony maintenance, bee colony activities, starting of new colony, location site, transferring colony, replacement of queen, combining colonies, swarm prevention, colony management in different seasons, Equipment for apiary, types of bee hives and their description. Bee pasturage. Honey extraction, honey composition and value, bee wax and tissues. Importance, History and development in India, silkworms kinds and their hosts, systematic position, distribution, lifecycles in brief, Silk glands. Mulberry silkworm- morphological features, races, rearing house and equipments, disinfection and hygiene. Grainage acid treatment, packing and transportation of eggs, Incubation, black boxing, hatching of eggs. Silkworm rearing young age /chawki rearing and old age rearing of silkworms. Feeding, spacing, environmental conditions and sanitation. Cocoon characters colour, shape, hardness and shell ratio. Defective cocoons and stifling of cocoons. Uses of silk and by-products. Economics of silk production. Moriculture- Mulberry varieties, package of practices, Pests and diseases and their management. Lac growing areas in India, Lac insects, biology, behaviour, lac cultivation, food plants, pruning, inoculation, cropping, kinds of lac. Enemies of lac-insects.

Practical

Honey bee colony, different bee hives and apiculture equipment. Summer and Winter management of colony. Honey extraction and bottling. Study of pests and diseases of honeybees. Establishment of mulberry garden. Preparation of mulberry cuttings, planting methods under irrigated and rain fed conditions. Maintenance of mulberry garden- pruning, fertilization, irrigation and leaf harvest. Mulberry pests and diseases and their management and nutritional disorders. Study of different kinds of silkworms and mulberry silkworm morphology, silk glands. Sericulture equipments for silkworm rearing. Mulberry silkworm rearing room requirements. Rearing of silkworms- chalky rearing. Rearing of silkworms late age silkworm rearing and study of mountages. Study of silkworm pests and their management. Study of silkworm diseases and its management. Lac insects- biology, behaviour, lac cultivation, food plants, pruning, inoculation, cropping, kinds of lac. Enemies of lac insects.

Teaching Schedule:

Lecture No.	Topic	Weightage (%)
1	Introduction to beneficial insects. Importance and History of apiculture.	20
2	Studies on different species of honey bees, morphology and anatomy.	
3	Studies on bee colony organization, life style and seasons management.	
4	Bee keeping equipments, types and social behavior of bee hives and their description.	10
5	Reproduction in bees and queen rearing. Bee pasturage, bee products and their uses. Economics of bee keeping.	
6	Bee enemies and diseases. Role of bees in pollinations.	
7	Importance, History and development of silkworms in India. Silk worms species and their hosts, systematic position, distribution, lifecycles in brief, Silk glands.	20
8-9	Mulberry silkworm- races. Moriculture-Mulberry varieties, package of practices.	
10	Rearing house and equipments, disinfection and hygiene.	
11	Grainage acid treatment, packing and transportation of eggs, Incubation, black boxing, hatching of eggs.	40
12	Silkworm rearing young age (chawki) rearing and old age rearing of silkworms.	
13	Feeding, spacing, environmental conditions and sanitation. Cocoon characters: colour, shape, hardiness and shell ratio.	
14	Defective cocoons and stifling of cocoons. Uses of silk and by-products. Economics of silk cocoon production.	
15	Pests and diseases of silkworm and their management.	10
16	Lac growing areas in India, Lac insects, biology. Lac cultivation, food plants, pruning, inoculation, cropping, kinds of lac. Enemies of lac-insects.	
Total		100

Practical Lesson plan

Ex. No.	Practical
1.	Honey bee colony and different bee hives and apiculture equipment.
2.	Seasonal management of bee colony-Summer and winter.
3.	Study of production of honey, handling and bottling.
4.	Study of pests and diseases of honeybees.
5.	Establishment of mulberry garden.
6.	Study of cultivation of mulberry under irrigated and rainfed conditions.
7.	Maintenance of mulberry garden-pruning, fertilization, irrigation and leaf harvest.
8.	Pests, diseases and nutritional disorders of mulberry crop and their management.

9.	Study of different species of silkworms species and morphology and anatomy of mulberry silkworm- Silk gland
10.	Rearing equipments and rearing room.
11.	Rearing of silkworms-chalky larvae.
12.	Rearing of silkworms late age silkworm and mountages.
13.	Study of silkworm pests and their management.
14.	Lac insects-biology, behaviour
15.	Lac cultivation, food plants, pruning, inoculation, cropping.
16.	Kinds of lac and their enemies.

Suggested Reading:

Text books:

K.P.Srivastava .A Text Book on Applied Entomology Vol.I&II. , Kalyani Publishers, Ludhiyana

Reference books:

Singh, S., 1975. Bee keeping in India – ICAR, New Delhi., 214p.

Sunita, N.D, Guled ,M.B, Mulla S.R and Jagginavar,2003, Beekeeping, UAS Dharwad

Mishra, R.C. and Rajesh Gar. 2002. Prospective in Indian Apiculture. Agrobios,

Jodhpur. Singh, D and Singh, D.P. 2006. A hand book of Beekeeping, Agrobios (India).

Paul DeBach and Devid Rosen 1991. Biological control by natural enemies.

Cambridge University Press; 2 edition (27 June 1991)

Y.A. Shinde and B.R. Patel. Sericulture in India

Tribhuvan Singh. Principles and Techniques of Silkworm Seed Production, Discovery publishing House Pvt. Ltd

M.L. Narasaiah. Problems and Prospects of Sericulture. discovery publishing House Pvt. Ltd.

Ganga,G. and SulochanaChetty, J. 1997. An introduction to Sericulture (2nd Edn.).Oxford & IBH publishing Co. Pvt. Ltd., New Delhi.

Krishnaswamy, S. (Ed). 1978. Sericulture Manual - Silkworm Rearing. FAO Agrl. Services bulletin, Rome.

Singh, S. 1975. Bee keeping in India. ICAR, New Delhi.

Glover, P.M. 1937. Lac cultivation in India. Indian Lac Research Institute, Ranchi.

Jolly, M.S. 1987. “Appropriate sericulture techniques” International centre for training and Research in Tropical Sericulture, Mysore, 209.

B.R. David and V.V.Ramamurthy. Elements of Economic Entomology, 7th Edition. Namrutha Publications, Chennai

e-reading: <http://ecourses.iasri.res.in/>

Course No. : H/ENTO 232

Title: Insect Pests of Vegetable, Ornamental and
Spice Crops

Credits : (2+1) 3

Semester-III

Theory

Economic importance of insects in vegetable, ornamental and spice crops -ecology and pest management with reference to these crops. Pest surveillance in important vegetable, ornamental and spice crops. Distribution, host range, bio-ecology, injury, integrated management of important insect-pests affecting vegetable, ornamental and spice crops.

Important storage insect-pests of vegetable, ornamental and spice crops, their host range, bio-ecology, injury and integrated management.

Insect –pests of processed vegetables and ornamental crops, their host range, bio-ecology, injury and integrated management.

Insecticidal residue problems in vegetables and ornamental crops, tolerance limits etc.

Practical

Study of symptoms, damage, collection, identification, preservation, assessment of damage/population of important insect-pests affecting vegetable, ornamental and spice crops in field and during storage.

Teaching Schedule

Theory

Lecture No.	Topic	Weightage (%)
1	Economic importance of insects in vegetable, ornamental and spice crops - ecology and pest management with reference to these crops	10
2	Pest surveillance in important vegetable, ornamental and spice crops. Good agricultural practices in relation to pest management	
3	Pests of Okra : Shoot and fruit borer, Fruit borer, Leaf roller, Jassid, Aphid, Whitefly, Mite	10
4	Pests of Brinjal : Shoot and fruit borer, Whitefly, Aphid, Jassid, Hadda beetle, Leaf webber, Mite Pests of Tomato : Fruit borer, Leaf eating caterpillar, Serpentine leaf miner, Leaf miner, Whitefly, Aphid, Mealybug	
5	Pests of Bell pepper / Capsicum : Thrips, Tobacco leaf eating caterpillar, Cutworm, Fruit borer, Whitefly, Mite	
6 & 7	Pests of Cruciferous and Root crops (Cabbage, Cauliflower, Brocoli, Knolkol, Raddish, Carrot) : Diamondback moth, Mustard sawfly, Aphid, Head borer, Cabbage butterfly, Leaf miner, Cluster caterpillar, Tobacco leaf eating caterpillar, Semilooper, Cabbage bug	10

8	Pests of Cucurbitaceous crops (Pumpkin, Ridge gourd, Bitter gourd, etc.) : Fruit fly, Pumpkin beetle, Blister beetle, Hadda beetle, Leaf miner, Aphid, Whitefly, Mite	15
9	Pests of Potato : Potato tuber moth, Cutworm, Aphid, Jassid, Leaf eating caterpillar, Epilachna beetle, Mite	
10	Pests of Sweet Potato and Yam Sweet Potato : Sweet potato leaf eating caterpillar, Sweet potato weevil Yam : Yam beetle, Mealybug, Scale insect, Sawfly	
11	Pests of Leafy vegetables (Amarathus, Coriender, Fenugreek, Spinach, Salad crops) : Cutworm, Leaf eating caterpillar, Aphid, Leafhopper, Mustard sawfly, Leaf miner, Pollu beetle	05
12	Pests of Peas & Beans : Pod borers, Aphid, Stem fly, Pulse beetle, Mite	
13	Pests of Roses : Aphid, Jassid, Thrips, Scale insect, Flower borer, Leaf eating caterpillar, Leaf cutting bees, Digger wasp, Termite, Mite	10
14	Pests of Chrysanthemum and Marigold : Aphid, Thrips, Whitefly, Jassid, Leaf miner, Lace bug, Bud borer, Leaf miner, Mite, Slug	
15	Pests of Jasmine and Tuberose : Budworm, Galleryworm, Tingid bug, Rose bud borer, Aphid, Thrips, Scale insect, Mite	05
16	Pests of Aster : Leafhopper, Black blister beetle, Leaf miner, Aphid, Mite	
17	Pests of Gladiolus : Seed corm maggot, Aphid, Thrips, Cutworm, Mite	
18	Pests of Gerbera : Whitefly, Leaf miner, Leaf eating caterpillar, Rose bud borer, Mite Pests of Carnation : Aphid, Thrips, Rose bud borer, Red spider mite	05
19	Pests of Lily, Anthurium and Orchids : Aphid, Thrips, Mite	
20	Pests of Black pepper : Pollu beetle, Mealy bug Pests of Clove : Stem borer, Scale	10
21	Pests of Cinnamon : Cinnamon butterfly, Leaf miner, Shoot and leaf webber, Chafer beetle	
22	Pests of Cardamom : Cardamom thrips, Shoot and capsule borer, Root grub, Capsule borer, Hairy caterpillar, Shoot fly	
23	Pests of Nutmeg and Mace : Scale	
24	Pests of Curry leaf (Psylla, Black fly, Lemon butterfly, Scale) Pests of Coriander, Cumin and Fennel (Aphid, Mite)	05
25	Pests of Turmeric and Ginger : Rhizome fly, Stem borer, Thrips, Scale insect, White grub	
26	Pests of Chilli : Thrips, Whitefly, Aphid, Fruit borer, Mite	
27	Pests of Onion and Garlic : Thrips, Cutworm, Onion fly, Earwig	
28	Integrated Pest Management in protected condition	15
29&30	Storage insect-pests of vegetable, ornamental and spice crops and their management	

31	Insect – pests of processed vegetable, ornamental and spice crops and their management	
32	Insecticidal residue problems in vegetables and ornamental crops : Definition of pesticide residue, acceptable daily intake, maximum residual limits, LD ₅₀ , LC ₅₀ , toxicity & its types, list of instrument for detection of pesticide residues and maximum residual limits of pesticides in vegetables, ornamental and spice crops	
	Total	100

Teaching Schedule
Practical

Practical No.	Topic
1	Pests of Okra
2	Pests of Brinjal
3	Pests of Tomato, Bell pepper / Capsicum
4	Pests of Cruciferous and Roost crops
5	Pests of Cucurbitaceous crops
6	Pests of Potato, Sweet potato, Yam
7	Pests of Leafy vegetable, Pea, Beans
8	Pests of Rose, Chrysanthemum, Marigold
9	Pests of Jasmine, Tuberose, Aster
10	Pests of Gladiolus, Gerbera, Carnation, Lily, Anthurium & Orchids
11	Pests of Black pepper, Clove
12	Pests of Cinnamon, Cardamom, Nutmeg & Mace
13	Pests of Curry leaf, Coriander, Cumin & Fennel, Turmeric & Ginger
14	Pests of Chilli, Onion & Garlic
15	Integrated Pest Management in Polyhouse
16	Insect-pests of storage & processed vegetable, ornamental and spice crops and their management

Reference books

Ayyar, T.V.R. 1963, Hand Book of Economics Entomology for South India.
Govt. Press Madras.

David, B.V. 2006. Elements of Economic Entomology. Popular Book Depot,
Chennai.

Butani, D.K. and M.G.Jotwani, 1984. Insects of Vegetables. Periodical Expert Book Agency, New Delhi.

Srivastava, K.P. and D.K.Butani, 1998. Pest Management in Vegetables (Part I & II) Research Periodicals and Book Publishing House, India.

e-reading: <http://ecourses.iasri.res.in/>