SYLLABUS: DEPARTMENT OF AGRICULTURAL ENTOMOLOGY

Courses by the Department of Agricultural Entomology in the M. Sc.(Ag.) programme

Course No	Course Title	Credit	Semester
AEN- 501*	Insect morphology	(1+1)	I
AEN- 502*	Insect anatomy, Physiology & Nutrition	(2+1)	I
AEN- 509	General Acarology	(1+1)	I
AEN- 515*	Principles of Integrated Pest Management	(2+1)	I
AEN- 503*	Insect taxonomy	(1+1)	II
AEN- 504*	Insect Ecology	(1+1)	II
AEN- 505*	Pest of Field crops and their management	(2+1)	II
AEN- 510	Insect embryology & post-embryonic development	(1+1)	II
AEN- 511	Storage entomology & vertebrate pest	(1+1)	II
AEN- 506*	Pest of Horticultural crops and their management	(2+1)	III
AEN- 507*	Biological control of crop pests and Weeds	(1+1)	III
AEN-508*	Toxicology of insecticides	(2+1)	III
AEN- 512	Commercial Entomology	(1+1)	III
AEN-513	Chemical pest control methods	(1+1)	IV
AEN-514	Insect-vectors of plant pathogens & their relationships	(1+1)	IV
AEN- 516	Host plant resistance to Insects	(1+1)	IV
AEN- 591*	Credit Seminar	(0+1)	IV
AEN- 599*	Master's Research (Thesis)	0+20	I to IV

*Compulsory Core courses for Master's Programme

AEN 501* **Insect morphology** **(1+1)**

Objectives:

To familiarize the students with principles of insect pest management, including concept and philosophy of IPM. Train students in computation of ETL, implementing IPM programmes.

Syllabus:

Theory

Principles, utility and relevance: insect body wall structure, cuticular outgrowths, colouration and special integumentary structures in insects, body tagmata, sclerites and segmentation. Head- Origin, structure and modification; types of mouthparts and antennae, tentorium and neck sclerites. Thorax- Areas and sutures of tergum, sternum and pleuron, pterothorax; Wings: structure and modifications, venation, wing coupling apparatus and mechanism of flight; Legs: structure and modifications. Abdomen- Segmentation and appendages; Genitalia and their modifications; Insect sense organs (mechano-, photo- and chemoreceptors).

Practical

Study of insect segmentation, various tagmata and their appendages; preparation of permanent mounts of different body parts and their appendages of taxonomic importance including male and female genitalia. Sense organs.

Learning Outcome:

After completion of the course students will be proficient enough to construct population model and economic use of pesticide model. Also able to take decision based on ETL estimation as well as to make the venture cost effective one.

AEN 502* Insect anatomy, physiology & nutrition (2+1)

Objectives:

To impart knowledge to the students on basic aspects of anatomy of different systems, elementary physiology, nutritional physiology and their application in entomology.

Syllabus:

Theory

Scope and importance of insect anatomy and physiology, modification and physiology of different systems- digestive, circulatory, respiratory, excretory, nervous, sensory, reproductive, musculature, endocrine and exocrine glands. Thermodynamics; physiology of integument, moulting; growth, metamorphosis and diapause. Insect nutrition- role of vitamins, proteins, amino acids, carbohydrates, lipids, minerals and other food constituents; extra and intra-cellular microorganisms and their role in physiology; artificial diets.

Practical:

Dissection of different insects to study comparative anatomical details of different systems; preparation of permanent mounts of internal systems; examination of insect haemocytes; preparation of various diets and estimation of consumption, and utilization of food by insect.

Learning Outcome:

After completion of the course students will acquire the knowledge on various physiological systems of insect. Also they will develop expertise in preparation of permanent slides.

AEN-503* Insect taxonomy (1+1)

Objectives:

To sensitize the students on theory and practice of classifying organisms. Also acquainted with the rules of governing the same.

Syllabus:

Theory:

Brief evolutionary history of Insects- introduction to phylogeny of insects, Importance of taxonomy. Hierarchic classification, major Classification of class Insecta. Species concept and types species. Variation in taxonomic characters- problems in identification of species; International Code of Zoological Nomenclature. Classification of insects with characters upto family level, Phylogenetic relationships among the insect's order. Salient taxonomic characters, special morphological features, number of species known, geographical distribution of agricultural important order- Isoptera, Orthoptera, Hemiptera, Thysanoptera,

Neuroptera, Lepidoptera, Diptera, Hymenoptera, Coleoptera, Strepsiptera, Thysanura, Dictyoptera. Taxonomic characters of the following families; Termitidae, Thripidae, Gryllidae, Tettigonidae, Acrididae, Cicadellidae, Membracidae, Delphacidae, Fulgoridae, Coccidae, Pseudococcidae, Aphididae, Psyllidae, Miridae, Reduvidae, Coreidae, Noctuidae, Pyralidae, Bombycidae, Arctiidae, Papilionidae, Tephritidae Cecidomyidae, Tachinidae, Braconidae, Tricogrammatidae, Ichneumonidae, Chalcididae, Apidae, Formicidae, Tenthredinidae, Chrysomelidae, Cuculionidae, Bostrychidae, Coccinellidae, Cerambycidae and Scarabidae.

Practical:

Study of orders of insects and their identification using taxonomic keys. Keys upto family level for some agricultural insect orders- Orthoptera, Isoptera, Hemiptera, Thysanoptera, Coleoptera, Diptera, Lepidoptera and Hymenoptera. Field visit to collect insects of different orders.

Learning Outcome:

At the end of the course students will acquire the knowledge of correct identification of an unknown insect up to family level.

AEN 504* **Insect ecology** **(1+1)**

Objectives:

To teach the students about the concepts of ecology, basic principles, distribution and abundance of organisms and their causes. To impart an idea of life tables, organization of communities and diversity indicies. Also to train the students in sampling methodology, calculation of diversity indicies, constructing life tables, relating insect population fluctuations to biotic and/or abiotic causes.

Syllabus:

Theory:

Principles of ecology and its divisions, concept of ecosystem and its different components:- abiotic components- climatic factors, edaphic factors, , biotic components- plants, animals and microorganisms, their role in the ecosystem, trophic level, food chain. Population ecology:- definition of population, density, characters of population growth, different growth forms. Natality and mortality. Law of population growth, biotic potential and environmental resistance. Life table and age structure, population dynamics-density dependant and density independent phenomenon. Intra and inter-specific phenomenon, population equilibrium. Community ecology and ecological engineering.

Practical:

Methods of sampling insects, estimation of densities of insect and understanding the distribution parameters- measures of central tendencies, poison distribution, negative binomial distribution. Determination of optimum sample size. Calculation of some diversity indices- Shannon's , Simpson's index and understanding their association and the parameters

that affect their values. Computation of life tables. Field visit to understand different ecosystems and study the insect occurrence in these systems. Day Degree calculation.

Learning Outcome:

After completion of the course students will be acquainted with the basic principles of ecology. Also they will learn the various types of interactions in the environment, population dynamics of insect. Lastly they develop expertise in construction of age specific Life Table of an insect.

AEN 505* Pest of field crops and their management (2+1)

Objectives:

To familiarize the students about nature of damage and seasonal incidence of insect pests that cause loss to major field crops and their effective management by different methods.

Syllabus:

Theory:

Pests of field crops and their distribution and relative importance in India, incidence pattern , succession in different growth stages of crops in different crop seasons, Off season behaviour- perpetuation , biology and annual generations, population fluctuation, out break-factors influencing, changing pattern of pests composition and management. Cereals (Rice, wheat, maize millet) and Sugarcane pests:- pest composition as influenced by locality, key pests, sporadic pests, rational management of them, Epidemiology of pests. Cotton and Jute pests:- region based dominancy, pest complex, climatic and plant factors influencing, morphological adaptations. Pest composition of pulses and oil seed crops. Specific pattern on different crop species, alternate host acquisition in different season, biological statistics, level of damage to crop and sustainable management.

Practical:

Field visit, collection and identification of important pests and their natural enemies; detection and estimation of infestation and losses in different crops; study the life history of important insect pests.

Learning Outcome:

After completion of the course students will be acquainted with various insect-pests of field crops their damage symptoms and learn the techniques of AESA based pest management.

AEN-506* Pest of horticultural crops and their management (2+1)

Objectives:

To impart knowledge on major pests of horticultural and plantation crops regarding the extent and nature of loss, seasonal history and their integrated management.

Syllabus:

Theory:

Pests composition of brinjal, okra, potato, tomato, chilli, cole crops, cucurbits in different agroclimatic zones of India, variation of dominance of different species w.r.t season. Seasonal history of occurrence, distribution and population growth peculiarities of key pests of important vegetables crops. A brief introduction of the characteristics of perennial crop pests, reason for multiplication and their perpetuation. Natural damage and symptoms at early (seedling) stages and fruit bearing stages, extent of damage and its reflection to ultimate yield. Pest infesting root, trunk and reproductive parts of the plants. Pest of Citrus, mango, banana, litchi, coconut, cashew nut and tea. Methods of controlling pests of orchard and plantation crops. Pests of Zinger, turmeric, cardamom, betelvine and ornamentals.

Practical:

Field visit, collection and identification of important insect-pests and their natural enemies of horticultural crops in the laboratory and field. Detection and estimation of infestation and losses in different vegetables crops; Distribution pattern of population build up. study the life history of important insect pests.

Learning Outcome:

After completion of the course students will be acquainted with various insect-pests of horticultural crops their damage symptoms and learn the techniques of AESA based pest management.

AEN-507* Biological control of crop pests and weeds (1+1)

Objectives:

To train the students with theory and practice of biological control, mass production techniques and field evaluation of various biological control agents like parasitoids, predators and various entomopathogenic & microorganisms.

Syllabus:

Theory:

History, principles and scope of biological control; important groups of parasitoids, predators and pathogens; principles of classical biological control- importation, augmentation and conservation. Biology, adaptation, host seeking behaviour of predatory and parasitic groups of insects. Role of insect pathogenic nematodes, viruses, bacteria, fungi, protozoa etc., their mode of action. Biological control of weeds using insects. Mass production of quality biocontrol agents- techniques, formulations, economics, field release/application and evaluation. Importation of natural enemies-Quarantine regulations, biotechnology in biological control. Insect Growth regulators and Botanicals in pest management

Practical:

Identification of common natural enemies of crop pests (parasitoids, predators, icrobes) and. Visits (only where logistically feasible) to bio-control laboratories to learn rearing and mass production of egg, egg-larval, larval, larval-pupal and pupal parasitoids, common predators, microbes and their laboratory hosts, phytophagous natural enemies of weeds. Field collection of parasitoids and predators.

Learning Outcome:

Upon completion of the course students will able to identify the common natural enemies of crop pests. They acquire the knowledge of mass production of egg, common predators, microbes and their laboratory hosts.

AEN 508* Toxicology of insecticides (2+1)

Objectives:

To orient the students with structure and mode of action of important insecticides belonging to different groups, development of resistance to insecticides by insects, environmental pollution caused by toxic insecticides and their toxicological aspects.

Syllabus:

Theory:

Scope and definition of insecticide toxicology. Classification of insecticides and acaricides based on mode of entry, mode of action and chemical nature. Structure and mode of action of organochlorines, organophosphates, carbamates, pyrethroids, tertiary amines, neonicotinoids, oxadiazines, phenyl pyrozoles, insect growth regulators, microbials, botanicals, new promising compounds, and some fumigants. Principles of toxicology; evaluation of insecticide toxicity; joint action of insecticides- synergism, co-toxicity ; relative toxicity; potentiation and antagonism; factors affecting toxicity of insecticides; insecticide compatibility,. Selectivity of insecticides—vertebrate selective ratio (V/S). Toxico-dynamics of insecticides (detoxification, reaction with the enzymes and metabolism) Biochemical basis of resistance development and its management.

Practical:

Insecticide formulations and mixtures; laboratory and field evaluation of bioefficacy of insecticides; bioassay techniques; probit analysis; evaluation of insecticide toxicity and joint action. Toxicity to beneficial insects. Working out doses and concentrations of pesticides; Safety evaluation of insecticides—MRL, ADI, FF, TL etc. visit to toxicology laboratories.

Learning Outcome:

After completion of the course students will be acquainted with toxico-dynamics of newer molecules. Also they will develop skills on the bioassay techniques also able to work out joint toxicity.

AEN 509 General acarology (1+1)

Objectives:

To aquaint the students with external morphology of different groups of mites, train in identification of commonly occurring families of plant associated mites, provide information about important mite pests of crops and their management.

Syllabus:

Theory:

Introduction to morphology and biology of mites and ticks. Broad classification- major orders and important families of Acari including diagnostic characteristics. Economic importance,

seasonal occurrence, nature of damage, host range of mite pests of different crops, mite pests in polyhouses, mite pests of stored products and honeybees. Management of mites using acaricides, phytoseiid predators, fungal pathogens etc. Culturing of phytophagous, parasitic and predatory mites.

Practical:

Collection and extraction of mites from plants, soil and store products.; Preparation of mounting media and slide mounts; external morphology of mites; identification of mites up to family level using keys; studying different rearing techniques for mites.

Learning Outcome:

After completion of the course the students will be acquainted with different groups of mite and their phytophagous nature to different crops. They will also develop skills on the identification of different groups of mite, their host range, management and mass culturing of phytophagous and predatory mites.

AEN-510 Insect embryology and post-embryonic development (1+1)

Objectives:
To aquaint the students with the embryonic & post-embryonic development of insects, types of metamorphosis. Focus will also be given to the different modes of reproduction, hatching, development of different organs and types of larva and pupa.

Syllabus:

Theory:

Embryonic and post-embryonic development; Types of metamorphosis. Development of Imago :- fertilization, development of oocyte, cleavage and blastoderm formation, germ band formation, blastokinesis. Organogenesis. Variation in development:- viviparity, polyembryony, parthenogenesis paedogenesis. Post embryonic development:- hatching and shedding of embryonic cuticle, number and duration of instars, types of larva, pupa and its significance, development of organs.

Practical:

Identification of different types of larvae and pupae. Morphometry of insect eggs, Morphological changes of egg cell during incubation period after hatching; observation of instars, body coloration before and after moulting, Larva- pupal intermediate, Pupal colourations with respect to tanning and hardening. Developmental comparison between nymph and adult. Sex related variation in adult insect. Healthy and deformed insect.

Learning Outcome:

After completion of the course the students will be acquainted with the different types of metamorphosis, larva and pupa found in insects. They will also learn about fertilization,

development of oocyte, blastoderm formation blastokinesis and organogenesis. They will also have a knowledge about the different types of reproduction in insects, hatcing and shedding of embryonic cuticle.

AEN 511 Storage entomology & vertebrate pest (1+1)

Objectives:

To focus on requirement and importance of grain and grain storage, to understand the role of stored grain pests and to acquaint with various stored grain pest management techniques for avoiding losses in storage. As well as to impart knowledge on vertebrate pests like birds, rodents, mammals etc.,

Syllabus:

Theory:

Ecology of occurrence of different storage pests and reasons for variation in different storage conditions and localities. Biological activities of different pest species, relationship of abundance in pest complex, nature and extent of damage by them, source of infestation. Different storage structures and method of storage. Role of different physical factors in storage hygiene and measure to counteract them. Important rodent pests associated with stored grains and their non-chemical and chemical control including fumigation of rat burrows. Role of bird pests and their management Control of infestation by insect pests, mites and microorganisms. Preventive measures- Hygiene/sanitation, disinfestations of stores/receptacles, legal methods. Curative measures-Non-chemical control- ecological, mechanical, ecological, biological and engineering. Chemical control- prophylactic and curative- Characteristics of pesticides, their use and precautions in their handling with special emphasis on fumigants. Integrated approaches to stored grain pest management.

Practical:

Field visit, collection, identification and familiarization with the stored grains, seeds insect pests and nature of damage caused by them. Detection of insect infestation in stored food grains; estimation of losses in stored grains; determination of moisture content in stored food grains, Visit to common storage structures. Calculations of required quantity of fumigants and insecticidal spray for different storage house.

Learning Outcome:

After completion of the course the students will be acquainted with the different storage pests of agricultural produce, their identification, nature of damage, measurement of loss caused by them and their management by non-chemical and chemical means. The students will also learn about the rodent pests of stored products and their management.

AEN-512 Commercial entomology (1+1)

Objectives:

To familiarize the students with entrepreneurial opportunities in entomology, provide information on productive insects and their products, as well as insect pests of public health and veterinary importance and their management of different crops, their biology, damage they cause and management strategies.

Syllabus:

Theory:

Apiculture:- Honey bee species occurring in India, morphology for identification of different bee species, society and social organization, caste differentiation, nest formation and behaviour, Methods of artificial /commercial rearing (apiary), care and protection of apiary. Sericulture:- silkworm species of commercial values, morphological character, systemic position, and distribution. Wild and semidomesticated and domesticated species- their host plant and types of silk produced by them. Mulberry silk production- moriculture including different species, variety, their propagation, cultivation methods and picking of leaves. Silk worm rearing:- requisites for local and scientific rearing, Grainage:- procedure for production of Dfls and commercial cocoon production. Protection from hazards. Lac culture:- Morphological peculiarities of different stages of development. Strains of lac insect, host plants and types of lac. Biological characteristics and life cycle of lac insect. Cultivation of lac host plant- pruning, coup system, preparation of schemes, inoculation and harvesting. Processing and marketing, Natural enemies of lac and their remedies.

Practical:

Identification of honey bee species, bee castes and special adaptations, identification and handling of bee-keeping equipments. Handling of honey bees-hive and frame inspection. Honey extraction and processing methods of hive products extraction. Preparation of bee-keeping projects for funding. Visit to bee nursery and commercial apiaries. Silkworm rearing and management. Lac host and crop management technology and processing of lac. Products and bye-products of lac.

Learning Outcome:

After completion of the course the students will be acquainted with apiculture - honey bees species, their identification, behavior and artificial rearing and care. The students will also be aquainted with Sericulture – different species of silkworm, their identification behavior and artificial rearing and care. The students will learn about moriculture also. Apart from these the students will learn about Lacculture, their different strains, life cycle inoculation and harvesting.

AEN 513 Chemical pest control (1+1)

Objectives:

To familiarize the students with management of insect-pests with respect to behavioural control (attractants, pheromones and repellants); antifeedants; chemosterilants and insecticidal control (different groups of insecticides their field properties) and their application techniques.

Syllabus:

Theory:

Behavioural control:- behaviour controlling agents, attractants- food lure, sex lure ; pheromones. Potential uses of them. Repellants- early chemical repellants, synthetic chemical repellents, major area of use and prospects. Antefeedants- chemical types, mode of action. Chemosterilants:- chemical types, structure activity relationship, mechanism of action, practical uses, sterile male release techniques and limitation. Insecticidal control:- kinds of insecticides in common use, characteristics of the major kind of insecticides. General field properties, formulations, principles involved and uses. Application of insecticides, selection of insecticides formulation and dose,and volume of field use formulation. Behaviour of droplet/particles after release from the equipment and deposition on target.

Practical:

Evaluation of different types of traps against fruit flies with respect to signals; behavioural study of Bees and flies under laboratory condition. Field evaluation of bioefficacy of insecticides; evaluation of insecticide toxicity and joint action. Toxicity to beneficial insects. Working out doses and concentrations of pesticides.

Learning Outcome:

After the completion of the course the students will be aquainted with the different means of insect-pest management in agricultural crops. They will also learn about the different application techniques of insecticides, their dosages, different types of chemical imposition appliances etc. under field condition.

AEN 514 Insect-vectors of plant pathogens & their relationships (1+1)

Objectives:

To teach the students about the different groups of insects that are vectors of plant pathogens, vector-plant pathogen interaction, management of vectors for controlling diseases

Syllabus:

Theory:

History of developments in the area of insects as vectors of plant pathogens. Important insect vectors and their characteristics; mouth parts and feeding processes of important insect vectors. Efficiency of transmission. Transmission of plant viruses and fungal pathogens. Relation between viruses and their vectors. Transmission of plant viruses by aphids, whiteflies, mealy bugs and thrips. Transmission of mycoplasma and bacteria by leaf hoppers and plant hoppers. Transmission of plant viruses by psyllids, beetles and mites. Epidemiology and management of insect transmitted diseases through vector management.

Practical:

Identification of common vectors of plant pathogens- aphids, leafhoppers, whiteflies, thrips, beetles, culturing and handling of vectors; demonstration of virus transmission through vectors- aphids, leafhoppers and whiteflies

Learning Outcome:

After the completion of the course the students will be acquainted with the different vectors of plant pathogens, their characteristics and process of transmission of plant viruses and fungal pathogens. The students will also learn about the management techniques of different vectors.

AEN 515 Principles of integrated pest management (2+1)

Objectives:

To familiarize the students with principles of insect pest management, including concept and philosophy of IPM. Train students in computation of ETL, implementing IPM programmes

Syllabus:

Theory:

History of Plant Protection, Plant Protection Organisation in India and International level. IPM Concept and philosophy, ecological principles, economic threshold concept. Concept and classification of pests, information required to tackle the pest problem-plant aspects, pest's aspect and environment aspects. Economic consideration, Simulation and modelling in plant protection. Merits and demerits of Integrated Pest Management. Tools of pest management and their integration- legislation, cultural, physical and mechanical methods; pest survey and surveillance, forecasting, types of survey including remote sensing methods, factors affecting surveys; political, social and legal implication of IPM. Case studies of successful IPM programmes. Semiochemicals and Biotechnology in crop protection. Resistance and its integrated management (IRM). Pesticides- Development, Formulations and Designing of pesticide application equipments, HV, ULV, LV spraying, dusting, seed treatment, soil application, heat treatment, fumigation fire & flame applicators, aerosol, aerial and granular application, encapsulation. Use of nanotechnology in insect pest management. Toxic hazards of pesticides in the ecosystem- soil, water, food, forest. Effect on non-target organism, phyto-toxicity. Safety measures in handling pesticides, precaution and antidotes.

Practical:

Crop loss assessment- direct losses, indirect losses, potential losses, avoidable losses and unavoidable losses. Assessment of pest population- direct & indirect assessment, Sampling requirements and methods, survey & surveillance, remote sensing. Acquaintances with registered pesticides in India and their formulations, Compatibility. Application of pesticides by various equipments, agricultural aviation. Decision making for pest control, Computation of EIL and ETL; Crop pest modelling, prediction model of crop pest. Calculation of benefit: cost ratio.

Learning Outcome:

After completion of the course students will be proficient enough to construct population model and economic use of pesticide model. Also able to take decision based on ETL estimation as well as to make the venture cost effective one.

AEN 516 **Host plant resistance to insects** **(1+1)**

Objectives:

To familiarize the students with types, basis, mechanisms and genetics of resistance in plants to insects and role of plant resistance in pest management of agricultural crops.

Syllabus:

Theory:

History and importance of resistance, principles, classification, components, types and mechanisms of resistance. Insect-host plant relationship, factors for insect feeding on plants — visual and gustatory stimuli, physical and mechanical characteristics of plants, chemical factors in plants, nutrients and secondary metabolites. Trophic plasticity in insect--- monophagism, oligophagism and polyphasigm, variation in development of polyphagous insects feeding on different host plants. Factors affecting plant resistance including biotypes and measure to combat them. Role of biotechnology in plant resistance to insects.

Practical:

Screening techniques for measuring resistance, measurement of plant characters and working their correlation with plant resistance. Bioassay of plant extracts of susceptible / resistance varieties; Demonstration of antibiosis, tolerance and antixenosis.

Learning Outcome:

After the completion of the course the students will be acquainted with insect-host plant relationship, bases of host plant resistance to insects, and different factors influencing feeding of plants by insects. The students will also learn about the role of biotechnology in insect-pest management.

Ph. D. Syllabus in the Department of Agricultural Entomology

Sl. No.	Course code	Name of the course	Credits
1	ENT 601	Advanced Economic Entomology and Integrated Pest Management	4+0
2	PPT 601	Research Methodology and Techniques in Plant Protection	4+0
3	PPT 602	Research Prelims	4+0

ENT 601 Advanced Economic Entomology and Integrated Pest Management 4+0

Objective:

To enable the students to get acquainted with the advanced parts of applied entomology related to commercial entomology**,** Integrated Pest Management modules for various agriculturally important crops, their assessment through statistical analysis etc. they will also learn about the various management strategy especially eco-friendly means of control.

Syllabus:

General account (importance, seasonal history, biology, nature of damage and symptoms) of the pests of cereals, pulses, oilseeds, fibre and stored grain pests. General account (importance, seasonal history, biology, nature of damage and symptoms) of the pests of vegetables, fruits and plantation crops. A brief account of Industrial Entomology (Sericulture, Apiculture and Lac culture). Principles of sampling and surveillance; database management and computer programming, simulation techniques and system analysis and modelling. Studies on parasites, predators, parasitoids and entomopathogens. Colonization, conservation and augmentation of natural enemies. Genetic engineering and new technologies – their progress and limitations. Scope and limitations of bio-intensive and ecological based IPM programmes. Application of IPM to farmer's real time situations. Penetration and distribution of insecticides in insect systems; insecticide selectivity; factors affecting toxicity of insecticides. Bio-chemical and physiological target sites of insecticides in insects. Developments in bio-rational, bio-pesticides and newer molecules; their modes of action and structure – activity relationships; activation, synergism and potentiation. Joint action of insecticides; activation, synergism and potentiation. Problems associated with pesticide use in agriculture; pesticide resistance mechanisms and resistant management strategies (IRM); Pest resurgence and outbreaks; persistence and pollution; health hazards and other side effects. Identification of different insect-pests, natural enemies. Isolation and mass multiplication of natural enemies and entomopathogens. Bioassays of recent insecticidal molecules and botanicals. Rearing of mulberry silkworm. Growth and development study.

Learning Outcome: