06 AGRICULTURAL ENTOMOLOGY/ENTOMOLOGY

Unit 1: Systematics

History and development of Entomology, Evolution of insects, position of insects in the animal kingdom, characteristics of phylum Arthropoda, structural features of important arthropod groups such as Trilobita, Chelicerata and Mandibulata, structural features of important classes of phylum Arthropoda viz. Arachnida, Crustacea, Chilopoda, Diplopoda and Hexapoda. Classification of insects up to order level, habits, habitats and distinguishing features of different Order and important Families.

Unit 2: Morphology

Body wall, its structure, outgrowths, endoskeleton, Body regions, segmentation, sclerites and sutures, Insect Colors. Head and head appendages, types of mouth parts, antennae, their structure and types. Thorax structure, thoracic appendages and their modification. Wings, their modification and venation, Abdomen; structure, abdominal appendages both in Pterygota and Apterygota. External genitalia, general structure and modification in important insect orders.

Unit 3: Embryology, Internal Anatomy and Physiology

Embryonic and post embryonic development, types of metamorphosis, physiology of ecdysis. General features and types of larvae and pupae. Structure, function, physiology and modifications of Digestive, Circulatory, Respiratory, Reproductive, Nervous, Excretory systems, Endocrine system and Sense Organs. Insect food and nutrition; minerals, carbohydrates, proteins and amino acids, lipids, vitamins and their role in growth and development, artificial diets.

Unit 4: Ecology

Concept of ecology, Environment and its components-biotic and abiotic factors and their effects on growth, development, diapause, population structure and dynamics, distribution and dispersal. Principles of biogeography and insects biodiversity. Assessment of diversity indices. Biotic potential and environmental resistance. Climate change and adaptations. Ecosystems, agroecosystem analyses, ecological niche, their characteristics and functioning. Intra and inter specific relationship; competition, predator-prey and host-parasitoid interactions. Food chain, food web and trophic relations. Life table studies, population models. Arthropod population monitoring, pest forecasting. Causes of pest out breaks.

Unit 5: Biological Control

Importance and scope of biological control, history of biological control: Biocontrol agents-parasitoids, predators, insect pathogens and weed killers. Important entomophagous insect Orders and Families. Ecological, biological, taxonomic, legal and economic aspects of biological control, phenomena of multiple parasitism, hyperparasitism, superparasitism and their applied importance. Principles and procedures of using exotic biocontrol agents. Utilization of natural biocontrol agents: conservation, habitat management and augmentation. Mass multiplication techniques and

economics. Effective evaluation techniques, Biocontrol organizations in world and India. Successful cases of biological control of pests. Use of biotechnological tools in enhancing the potentials of Bio-Control Agents.

Unit 6: Chemical Control and Toxicology

History, scope and principles of chemical control. Insecticides, classification and mode of action - Conventional and IRAC. Formulations of insecticides. Penetration of insecticides. Physical, chemical and toxicological properties of different groups of insecticides. rodenticides, insect growth hormones. Insecticide induced resurgence. Combination insecticides. Pesticide hazards and environmental pollution. Safe use of pesticides, precautions, first aid treatments and antidotes. Insecticides Act 1968, Functions of CIB & RC, registration and quality control of insecticides. Evaluation of toxicity, methods of toxicity testing, determination of LD 50, LT 50, RL 50 etc. Pesticide residues in the environment and their dynamics of movements, methods of residue analysis. Good laboratory practices. Pharmacology of insect poisons. Metabolism of insecticides; detoxification enzymes and their role in metabolism. Selectivity of insecticides insecticide resistance; mechanism, genetics and management of insecticide resistance.

Unit 7: Host Plant Resistance

Principles of HPR. Basis of resistance (Antixenosis, Antibiosis, Tolerance). Host plant selection by phytophagous insects. Biophysical and biochemical bases of defense against phytophagous insects. Genetics of Resistance: vertical resistance, horizontal resistance, oligogenic resistance, polygenic resistance. Biotype development and break down of resistance. Tritrophic interactions, induced resistance. Breeding for insect resistant crops and evaluation techniques. Biotechnological approaches and development of transgenic insect resistant plants, its advantages and limitations. Case histories. Insect resistance to transgenic plants and its management.

Unit 8: Novel Approaches in Pest Control

Behavioural control: semiochemicals pheromones-types and uses, advantages and limitations. Hormonal control: types and function of insect hormones, insect hormone mimics, advantages and limitations. chemosterilants, antifeedants, attractants, repellents; their types, method of applications, advantages and limitations. Genetic control: concepts and methods, case histories, advantages and limitations. Genetic improvement and genetic engineering of bio control agents. Pest management in organic agriculture. Pest management in precision agriculture.

Unit 9: Integrated Pest Management

History, concept and principles of IPM. Components of IPM: Host plant resistance, cultural, mechanical, physical, chemical, biological, genetic and behavioural control etc. System approach, Agro ecosystem and cropping system vs. IPM. Concept of damage levels- Economic threshold levels (ETL), Economic injury levels (EIL) and their determination. IPM strategies for field and horticultural crops. IPM case histories. Constraints and Strategies of IPM implementation. Plant quarantine laws and regulations.

Unit 10: Pesticide Application Equipment

Types of appliances: sprayers, dusters, fog generators, smoke generators, soil injecting guns, seed treating drums, flame throwers, etc. Types of nozzles, international classification, their uses, spray patterns, particle size, measurement, drift and non target effects of pesticides. Maintenance of appliances. Aerial application-principles, guidelines, factors affecting the effectiveness, systems, advantages and disadvantages.

Unit 11: Pests of Field Crops and their Management

Distribution, host range, biology and bionomics, nature of damage and management of arthropod pests of cereals, millets, nutricereals, oilseeds, pulses, fibre crops, green manures, sugarcane and tobacco. Pests of importance: locusts, termites, hairy caterpillars, cut worms white grubs and invasive alien pests. Vertebrate and molluscan pests.

Unit 12: Pests of Horticultural Crops and their Management

Distribution, host range, biology and bionomics, nature of damage and management of arthropod pests of vegetables, fruits, plantation crops, spices, condiments, medicinal and aromatic crops, ornamentals, underutilized and exotic fruits. Pest management under protected cultivation. Pests of mushrooms. Vertebrate and molluscan pests.

Unit 13: Pests of Stored Products and their Management

Principles of grain storage. Storage structures, bulk storage and bag storage their merits and demerits. Grain drying methods and aeration. Storage losses, sources of infestation, factors influencing losses. Insect pests in storage, biology, and nature of damage. Non-insect pests (rodents, birds, mites) and their nature of damage. Management methods: Physical, Mechanical, Chemical, Biological, Behavioural, Legal and special storage methods. Microflora in storage environment and their control. Regulated and quarantine pests. Integrated management of storage pests.

Unit 14: Insect and mite vectors of Plant Diseases

History of vector pathogen interactions, important vectors of plant diseases, ecology of vector pathogen interaction Common insect and mite vectors *viz*., aphids, leaf hoppers, plant hoppers, whiteflies, thrips, psylids, beetles, weevils, flies, and mites and their relationship with the plant pathogenic fungi, bacteria, viruses, mycoplasma. Mechanism of pathogen transmission: Active mechanical transmission, biological transmission. Toxicogenic insects, mites and phytotoxemia. Some important arthropod vector transmitted diseases and their epidemiology in India. Management of vector and its effect on control of diseases. Role of climate change in vector borne diseases.

Unit 15: Honey Bees and Bee-keeping

History of bee-keeping. Honey bees and their economic importance. Bee products. Bee species, their behaviour, habit and habitats. Bee Keeping: bee pasturage, hives and equipments, seasonal

management. Bee poisoning. Bee enemies including diseases and their management. Quality analysis of honey. Pollinators and their role in production of various crops. Conservation of pollinators.

Unit 16: Silkworms and Sericulture

Silkworm species, salient features, systematic position. Production techniques of mulberry, muga, eri and tassar silkworms. Nutritional requirements of silkworms. Sericulture: rearing house and appliances, silkworm breeds, principles of voltinism and moultinism, seed production and its economics. Different molecular approaches in developing silkworm breeds. transgenic silkworm-Mulberry pests, diseases and their management. By products of sericulture and its value addition, uses in pharmaceutical industry. Enemies and diseases of silkworms and their management. Sericulture organization in India.

Unit 17: Lac Insect

Lac insect, its biology, habit and habitats, lac products, uses. Host Trees: pruning, inoculation, lac cropping techniques, and harvesting. Enemies of lac insect and their control

Unit 18: Helpful and Useful Insects

Pollinators and their role in production of various crops. Conservation of pollinators. Pollinators, insects as food, soil fertility improving agents, scavengers. Use of insects and insect products in medicines. Insects as bio-indicators. Usefulness of insects in scientific investigations

Unit 19: Statistics and Computer Application

Frequency distribution, mean, mode and median. Standard, normal, bionomial and Poisson's distribution, Sampling methods and standard errors. Correlation and regression: Partial and multiple, tests of significance; t, F, chi- square, Duncan's multiple range tests. Design of experiments: Principles of Randomized block design, Completely randomized block design, Latin square design, Split-plot designs. Probit analysis. Use of software packages like SPSS, SAS, etc. for the above tests and designs of experiments for analysis.