

DEPARTMENT OF ZOOLOGY, UNIVERSITY OF ALLAHABAD

Syllabus of M.Sc. **Agricultural Entomology** based on Choice Based Credit System (CBCS), 2024-25

Semester I
AGE 501: Insect Morphology UNIT I: General characters of an insect; insect body wall, its structure and derivatives; cuticular outgrowths, segmentation, sclerites and sutures. UNIT II: Head: structure and modification; tentorium; structure and types of mouthparts and antennae. UNIT III: Thorax: general structure; Wings: structure and modification, wing venation, wing coupling apparatus; Legs: structure, types and modifications. UNIT IV: Abdomen: Structure; Segmentation and appendages, genitalia and their modifications in important insect orders; Stridulatory organs and sound producing organs. AGE 502: Systematics of Insects Unit I: Origin and evolution of insects, Importance of taxonomy. Hierarchic classification, types species. Procedures in taxonomy, International Code of Zoological Nomenclature. Collection and Preservation of Insects. Unit II: Major Classification of class Insecta. Habits, Habitats, distinguishing characters and classification of order upto super Family: Thysanura, Isoptera, Odonata, Orthoptera, Dictyoptera. Unit III: Habits, Habitats, distinguishing characters and classification of order upto super Family: Dermaptera, Thysanoptera, Hemiptera, Neuroptera, Strepsiptera. Unit IV: Habits, Habitats, distinguishing characters and classification of order upto super Family: Trichoptera, Lepidoptera, Coleoptera, Hymenoptera and Diptera. AGE 503: Insect anatomy and physiology Unit I: Structure, modification and physiology of digestive system. Food, nutrients and nutrition; minerals, carbohydrates, proteins, lipids and their role in growth and development; artificial diets. Unit II: Structure, modification and physiology of circulatory and respiratory systems. Unit III: Structure, modification and physiology of nervous system, sensory organs and muscular system. Unit IV: Structure, modification and physiology of excretory and reproductive system. AGE 504: Insect Ecology and Behaviour Unit I: Insects Community structure & dynamics. Effect of Environmental factors on growth, development, population dynamics and distribution of insects. Insect plant interactions. Unit II: Arthropod population monitoring, Pest forecasting. Diapause and causes of out breaks.

DEPARTMENT OF ZOOLOGY, UNIVERSITY OF ALLAHABAD

Characterization of insect colonization, k and r Strategies. Community ecology- Concept of guild, Organisation of communities-Hutchinson Ratio, May's d/w, Relation between the two and their association with Dyar's Law and Przibram's law.

Unit III: Introduction to insect behaviour. Mechanisms of Insect Behaviour: Sensory perception of insects, Control of insect behaviour: genetic, neural, physiological, environmental. Defence behaviour: Passive defence: crypsis, aposematic defenses, mimicry, passive and systemic chemical defences; active defences: startle, attack; group defence.

Unit IV: Insect Behaviour and the Environment: Orientation, Migration and navigation. Insect Communication: Visual, Mechanical and Chemical. Reproductive Behaviour: Mate finding and selection, Mate competition and courtship behaviour, Parental care. Social Behaviour: Cooperative living and altruism, Aggressive Behaviour.

AGE 531: Lab Course/Practical

AGE 532: Field visit and report

Semester-II

AGE 505: Insect Embryology and Endocrinology

Unit I: Insect Egg, Fertilization, Early Embryonic Development: Cleavage and the blastoderm, Gastrulation, Blastokinesis; Post Embryonic development: Metamorphosis-types; general features and types of larvae and pupae.

Unit II: Unusual types of development: Viviparity, Polyembryony, Parthenogenesis, Pedogenesis, Polyphenism. Diapause.

Unit III: Exocrine and Endocrine glands, their structure and function.

Unit IV: Hormones: Structure, transport, function and its mode of action; Regulation of hormone titer; Hormonal control of growth, metamorphosis and diapause.

AGE 506: Insect Toxicology

Unit: I: History, scope and principles of chemical controls; Insecticides and their classification, Structure and mode of action of organochlorines, organophosphates, carbamates, pyrethroids, chlordimeform, neonicotinoids, oxadiazines, phenyl pyrazoles, botanicals, chitin synthesis inhibitors, avermectins and fumigants; Systemic insecticides.

Unit II: Principles of toxicology; evaluation of insecticide toxicity; determination of LD₅₀, LT₅₀, LC₅₀, etc., joint action of insecticides- synergism, potentiation and antagonism; factors affecting toxicity of insecticides; insecticide compatibility, selectivity and phytotoxicity.

Unit III: Insecticide formulations; Methods of application of insecticides, appliances; Aerial application of insecticides; Insecticide metabolism; detoxification enzymes and their role in

DEPARTMENT OF ZOOLOGY, UNIVERSITY OF ALLAHABAD

metabolism; Insecticides resistance, mechanisms, types, and genetics of insecticide resistance; management and pest resurgence.

Unit IV: Pesticide residues, their significance and environmental implications; Insecticide Act, registration and quality control of insecticides; safe use of pesticides; diagnosis and treatment of insecticide poisoning. Basic concept involved in choosing pesticides in IPM.

AGE 507: Plant Resistance to Insects

Unit I: History and importance of plant resistance, principles, classification, components, types and mechanisms of plant resistance to insects. Factors affecting plant resistance including biotypes and measures.

Unit II: Insect-host plant relationships: theories and basis. Chemical ecology, tritrophic interactions. Secondary plant metabolites and their defences against phytophagous insects.

Unit III: Basis of resistance: Antixenosis, Antibiosis, Tolerance, acquired and induced resistance. Resistance development, evaluation techniques.

Unit IV: Genetic of resistance: Vertical, horizontal, oligogeneic and polygeneic resistance. Biotechnological approaches of development of transgenic resistant plants. Insect resistance to transgenic plants and its management. Successful examples of resistant crop varieties in India and world.

AGE 508: Insect Vectors of Plant Diseases

Unit I: Historical background of Insect vector-borne plant disease. Important insect vectors and their characteristics; mouth parts and feeding processes of important insect.

Unit II: Insect vectors and their relationship with Plant pathogenic viruses, bacteria, Fungi and Mycoplasma. Mechanism of Pathogen transmission; Transmission efficiency.

Unit III: Transmission of plant viruses by aphids, whiteflies, mealy bugs, thrips, psyllids, and beetles.

Unit IV: Transmission of mycoplasma and bacteria by insects (leaf hoppers, plant hoppers etc.). Epidemiology and management of insect vector transmitted diseases.

AGE 533: Lab Course/Practical

AGE 534: Field visit and report

Semester-III

AGE 509: Principles of Integrated Pest Management

Unit-I: Causes of success of insects, Origin of insect pests; History of insect pest control; Basic principles and components of insect pest management; Mechanical control, Physical control

Unit-II: Cultural control: Crop rotation, tilling the soil, destruction of places of breeding or over

DEPARTMENT OF ZOOLOGY, UNIVERSITY OF ALLAHABAD

wintering refuge, destruction or provision of alternate hosts, time of planting and harvesting, trap crops, nutrient management, clean cultivation etc., Biological Control.

Unit-III: Chemical control: synergists, formulations, application and appliances, repellents, attractants, botanicals, Synthetic organic insecticides, Pest resurgence and physiology of insecticidal resistance

Unit-IV: Innovative approaches of pest control: behavioural control, hormonal control and genetic control, IGR: JH Mimics & MH-agonist; Transgenic plants: history, *Bacillus thuriengensis* and its mode of action on insect, development of *Bt* plant by recombinant DNA technology, resistance management of *Bt*-crop, prospective and controversies of *Bt*-crop.

AGE 510: Pests of Agricultural crops

Unit I: Systematic position, identification, distribution, host range, biology, bionomics, nature of damage and management of insect pest of cereals, oilseeds and pulses.

Unit II: Systematic position, identification, distribution, host range, biology, bionomics, nature of damage and management of insect pests of vegetables, fruits and plantation crops.

Unit III: Systematic position, identification, distribution, host range, biology, bionomics, nature of damage and management of insect pests of fibre crops, sugar cane and spices.

Unit IV: Distribution, host range, biology, bionomics, nature of damage and management of Polyphagous pests: grasshopper, locusts, termites, hairy caterpillars, cut-worms and white grubs.

AGE 511: Medical and Veterinary Entomology

Unit I: Brief introduction to carriers and Vectors, insect reservoirs and hosts vector relationship. Adaptation in insect to act as vectors, Forensic entomology – basic concept and its importance.

Unit II: The biology, life history, mode of transmission, type of injury or infection, diseases, treatment and control of mosquitoes, sand flies, tsetse fly, human flea (*Pulex irritans*), head louse (*Pediculus humanus*) and bed bug (*Cimex hemipterus*) and blow flies.

Unit III: Introduction to Veterinary entomology. Common insect orders of veterinary importance. Molecular tools used in veterinary entomology.

Unit IV: The biology, life history, mode of attack, nature of injury and infection, damage or loss, treatment and control of stableflies (*Stomoxys morsitans*), equine botflies (*Gasterophilus intestinalis*). Cattle tick (*Boophilus microplus*), chicken mite (*Dermanyssus gallinae*) cattle blood sucking lice (*Linognathus vituli*) and cattle warblefly (*Hypodermabovis*).

AGE 512: Stored Grain Pest and their Management

Unit I: Introduction, history of storage entomology. Important pests viz., insects, rodents, birds and microorganisms associated with stored grain and field conditions including agricultural products.

DEPARTMENT OF ZOOLOGY, UNIVERSITY OF ALLAHABAD

Unit II: Grain storage- types of storage structures i.e., traditional, improved and modern. Ideal seeds storage conditions, Ecology of insect pests of stored grains with special emphasis on role of moisture, temperature and humidity in safe storage. Stored grain deterioration process, physical and biochemical changes and consequences.

Unit III: Systematic position, identification, distribution, host range, biology, nature and extent of damage of important stored grain pests of rice, wheat and pulses.

Unit IV: Control of infestation by insect pests. Preventive measures- Hygiene/sanitation, disinfestations of stores/receptacles, legal methods. Curative measures, non-chemical control measures- ecological, mechanical, physical, cultural, 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.

AGE 535: Lab Course/Practical

AGE 536: Field visit and report

Semester- IV

AGE 513: Biostatistics and Computer Application

Unit I: Basic definitions and applications, Sampling techniques, Data collection and presentation: types of data, methods of data collection, tabular and graphical representation of data.

Unit II: Frequency distribution, Measures of central tendency: mean, median, mode; Measures of variability of variation: Range, Interquartile range, standard deviation, variance; Correlation and regression: positive and negative correlation, ANOVA.

Unit III: Tests of significance: Chi-square, t-test, F-test, Duncan's Multiple Range Test, large sample test (Z test) and standard error. Introduction to probability theory and distribution; standard, binomial, poisson's and normal distributions. Probit Analysis.

Unit IV: Design of Experiments, Introduction to computers and computer applications, MS Office, spreadsheets and presentation software. Uses of software packages like SPSS, SAS, etc.

Note: *The candidate may opt any two of the following electives*

AGE 551: Biological Control of Insects

Unit I: History, principles and scope of biological control; important groups of parasitoids, predators and pathogens; Principles of classical biological control- introduction, augmentation, Inundation and conservation.

Unit II: 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.

Unit III: Mass production of quality bio-control agents- techniques, formulations, economics, field

DEPARTMENT OF ZOOLOGY, UNIVERSITY OF ALLAHABAD

release/application and evaluation.

Unit IV: Successful biological control projects, analysis, trends and future possibilities of biological control. Import of natural enemies- Quarantine regulations; Biotechnology in biological control.

AGE 552: Plant Quarantine

Unit I: History of quarantine legislations, Quarantine: domestic and international. Quarantine restrictions in the movement of agricultural produce, seeds and planting material; Exotic pests/diseases and their status.

Unit-II: Plant Bio-security and Bio-safety: Invasive alien species, Bio-warfare, National Regulatory Mechanism and International Agreements/Conventions; issues related to GM crops; strategies for combating risks and costs associated with agro-terrorism.

Unit-III: Identification of plant pest/diseases prevalence; contamination of food with toxigens, microorganisms and their elimination; Symptomatic diagnosis and other techniques to detect pest/pathogen infestations; VHT and other safer techniques of dis-infestation of infected material.

Unit-IV: Industrial registration; APEDA, Import and Export of bio-control agents. WTO regulations; non-tariff-barriers; Pest risk analysis; pesticide industry; Sanitary and Phytosanitary measures. Principles and Procedures of Certification: Role of international agencies in certification and quality control, fixing tolerance limits for diseases and insect pests in certification, accreditation of seed testing laboratories.

AGE 553: Commercial Entomology

Unit I: General introduction of commercially important insect orders, Historical and cultural aspects. Insect products and their marketing, government policies, Skill India and Startups in commercial entomology. Insect as food source, medicines, pollinators.

Unit II: Biology, characteristic and life history of silk worms. Silk and its uses, adulteration, , rearing, diseases, parasites and management of silkworms.

Unit III: Study of different species of honey bees, life history, behaviour and habitats, bee keeping, diseases, enemies and parasites of honey bees. Production and marketing of quality honey and value added honey products, adulteration. Establishment and maintenance of apiaries.

Unit IV: Lac insects its biology, habit and habitat, lac culture, commercial uses, natural enemies and their management.

AGE 554: Pest of Horticultural Crops

Unit I: Systematic position, identification, distribution, host-range, bionomics, nature and extent of damage, seasonal abundance and management of insect pests of important fruit crops.

Unit II: Systematic position, identification, distribution, host-range, bionomics, nature and extent of

DEPARTMENT OF ZOOLOGY, UNIVERSITY OF ALLAHABAD

damage, seasonal abundance and management of insect pests of major vegetable crops.

Unit III: Systematic position, identification, distribution, host-range, bionomics, nature and extent of damage, seasonal abundance and management of insect pests of plantation crop-

Unit IV: Systematic position, identification, distribution, host-range, bionomics, nature and extent of damage, seasonal abundance and management of insect pests of ornamental, medicinal and aromatic plants and pests in polyhouses/protected cultivation.

AGE 555: Dissertation

AGE 537-541: Lab Course/Practical

AGE 542: Field visit and report