# ENTOMOLOGY

**Course Structure – at a Glance**

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*Compulsory for Master’s programme; ** Compulsory for Ph.D. programme
ENTOMOLOGY
Course Contents

ENT 501  INSECT MORPHOLOGY  1+1

Theory
UNIT I
Principles, utility and relevance: insect body wall structure, cuticular outgrowths, colouration and special integumentary structures in insects, body tagmata, sclerites and segmentation.

UNIT II
Head- Origin, structure and modification; types of mouthparts and antennae, tentorium and neck sclerites.

UNIT III
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.

UNIT IV
Abdomen- Segmentation and appendages; Genitalia and their modifications; Embryonic and post-embryonic development; Types of metamorphosis. 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.

Suggested Readings


ENT 502  INSECT ANATOMY, PHYSIOLOGY AND NUTRITION  2+1

Theory
UNIT I
Scope and importance of insect anatomy and physiology.

UNIT II
Structure, modification and physiology of different systems- digestive, circulatory, respiratory, excretory, nervous, sensory, reproductive, musculature, endocrine and exocrine glands.

UNIT III
Thermodynamics; physiology of integument, moulting; growth, metamorphosis and diapause.
UNIT IV
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; chromatographic analysis of free amino acids of haemolymph; determination of chitin in insect cuticle; examination of insect haemocytes; determination of respiratory quotient; preparation and evaluation of various diets; consumption, utilization and digestion of natural and artificial diets.

Suggested Readings

ENT 503 PRINCIPLES OF TAXONOMY and CLASSIFICATION OF INSECTS 2+1

Theory
UNIT I
Introduction to history and principles of systematics and importance. Levels and functions of systematics. Identification, purpose, methods character matrix, taxonomic keys. Descriptions- subjects of descriptions, characters, nature of characters, analogy vs homology, parallel vs convergent evolution, intraspecific variation in characters, polythetic and polymorphic taxa, sexual dimorphism.

UNIT II
Classification of animals: Schools of classification- Phenetics, Cladistics and Evolutionary classification. Components of Biological Classification: Hierarchy, Rank, Category and Taxon. Species concepts, cryptic, sibling and etho-species, infra-specific categories. Introduction to numerical, biological and cytogenetical taxonomy.

UNIT III

UNIT IV
Brief evolutionary history of Insects- introduction to phylogeny of insects and Major Classification of Superclass Hexapoda – Classes – Ellipura (Collembola, Protura), Diplura and Insecta- Orders contained.

UNIT V

UNIT VI
Distinguishing characters, general biology, habits and habitats of Insect orders and economically important families contained in them (Continued). Division Neoptera – Subdivision Endopterygota, Section Neuropteroid- Coleopteroid Orders: Strepsiptera, Megaloptera, Raphidioptera, Neuroptera and Coleoptera, Section Panorpoid Orders Mecoptera, Siphonaptera, Diptera, Trichoptera, Lepidoptera, and Section Hymenopteroid Orders: Hymenoptera.

Practical

Suggested Readings
ENT 504 INSECT ECOLOGY 1+1

Theory

UNIT I

UNIT II

UNIT III

UNIT IV

Practical
indices- Shannon’s, Simpson’s and Avalanche Index and understanding their associations and parameters that affect their values. Problem solving in ecology. Field visits to understand different ecosystems and to study insect occurrence in these systems.

**Suggested Readings**


**ENT 505 INSECT PATHOLOGY 1+1**

**Theory**

UNIT I

History of insect pathology, infection of insects by bacteria, fungi, viruses, protozoa, rickettsiae, spiroplasma and nematodes.

UNIT II

Epizootiology, symptomatology and etiology of diseases caused by the above and the factors controlling these. Defense mechanisms in insects against pathogens.

UNIT III

Examples of successful instances of exploitation of pathogens for pest management and mass production techniques of pathogens. Safety and registration of microbial pesticides. Use of insect pathogens in integrated management of insect pests.

**Practical**

Suggested Readings

**ENT 506 BIOLOGICAL CONTROL OF CROP PESTS AND WEEDS 1+1**

**Theory**
UNIT I  
History, principles and scope of biological control; important groups of parasitoids, predators and pathogens; principles of classical biological control- importation, augmentation 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. Biological control of weeds using insects.

UNIT III  
Mass production of quality biocontrol agents- techniques, formulations, economics, field release/application and evaluation.

UNIT IV  
Successful biological control projects, analysis, trends and future possibilities of biological control. Importation of natural enemies- Quarantine regulations, biotechnology in biological control. Semiochemicals in biological control.

**Practical**
Identification of common natural enemies of crop pests (parasitoids, predators, microbes) and weed killers. 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. Hands-on training in culturing, identification of common insect pathogens. Quality control and registration standards for biocontrol agents.

Suggested Readings

**ENT 507 TOXICOLOGY OF INSECTICIDES 2+1**

**Theory**

**UNIT I**
Definition and scope of insecticide toxicology; history of chemical control; pesticide use and pesticide industry in India.

**UNIT II**
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, new promising compounds, etc.

**UNIT III**
Principles of toxicology; evaluation of insecticide toxicity; joint action of insecticides- synergism, potentiation and antagonism; factors affecting toxicity of insecticides; insecticide compatibility, selectivity and phytotoxicity.

**UNIT IV**
Insecticide metabolism; pest resistance to insecticides; mechanisms and types of resistance; insecticide resistance management and pest resurgence.

**UNIT V**
Insecticide residues, their significance and environmental implications. Insecticide Act, registration and quality control of insecticides; safe use of insecticides; diagnosis and treatment of insecticide poisoning.

**Practical**
Insecticide formulations and mixtures; quality control of pesticide formulations; laboratory and field evaluation of bioefficacy of insecticides; bioassay techniques; probit analysis; evaluation of insecticide toxicity and joint action. Toxicity to beneficial insects. Pesticide appliances. Working out doses and concentrations of pesticides; visit to toxicology laboratories. Good laboratory practices.

**Suggested Readings**

**ENT 508 PLANT RESISTANCE TO INSECTS 1+0**

**Theory**

**UNIT I**
History and importance of resistance, principles, classification, components, types and mechanisms of resistance.

**UNIT II**
Insect-host plant relationships; theories and basis of host plant selection in
phytophagous insects.

UNIT III
Chemical ecology, tritrophic relations, volatiles and secondary plant substances; basis of resistance. Induced resistance - acquired and induced systemic resistance.

UNIT IV
Factors affecting plant resistance including biotypes and measures to combat them.

UNIT V
Screening techniques; breeding for insect resistance in crop plants; exploitation of wild plant species; gene transfer, successful examples of resistant crop varieties in India and world.

UNIT VI
Role of biotechnology in plant resistance to insects.

Practical
Screening techniques for measuring resistance; measurement of plant characters and working out their correlations with plant resistance; testing of resistance in important crops; bioassay of plant extracts of susceptible/resistant varieties; demonstration of antibiosis, tolerance and antixenosis.

Suggested Readings

**ENT 509 PRINCIPLES OF INTEGRATED PEST MANAGEMENT 1+1**

**Theory**

UNIT I
History and origin, definition and evolution of various related terminologies.

UNIT II
Concept and philosophy, ecological principles, economic threshold concept, and economic consideration.

UNIT III
Tools of pest management and their integration- legislative, cultural, physical and mechanical methods; pest survey and surveillance, forecasting, types of surveys including remote sensing methods, factors affecting surveys; political, social and legal implications of IPM; pest risk analysis; pesticide risk analysis; cost-benefit ratios and partial budgeting; case studies of successful IPM programmes.

Practical
Characterization of agro-ecosystems; sampling methods and factors affecting sampling; population estimation methods; crop loss assessment; direct losses, indirect losses, potential losses, avoidable losses, unavoidable losses. Computation of EIL and ETL; crop modeling; designing and implementing IPM system.
Suggested Readings

ENT 510 PESTS OF FIELD, HORTICULTURAL AND PLANTATION CROPS AND STORAGE ENTOMOLOGY 3+1

UNIT I
Insect pests of cereals and millets and their management. Polyphagous pests: grasshoppers, locusts, termites, white grubs, hairy caterpillars, and non-insect pests (mites, birds, rodents, snails, slugs etc.).

UNIT II
Insect pests of pulses, tobacco, oilseeds and their management.

UNIT III
Insect pests of fibre crops, forages, sugarcane and their management.

UNIT IV
Fruit Crops- mango, guava, banana, jack, papaya, pomegranate, litchi, grapes, ber, fig, citrus, aonla, pineapple, apple, peach and other temperate fruits.

UNIT V
Vegetable crops- tomato, potato, radish, carrot, beetroot, cole crops, french beans, chow-chow, brinjal, okra, all gourds, gherkin, drumstick, leafy vegetables etc.

UNIT VI
Plantation crop- coffee, tea, rubber, coconut, arecanut, cashew, cocoa etc.; Spices and Condiments- pepper, cardamom, clove, nutmeg, chillies, turmeric, ginger, beetlevine etc.

UNIT VII
Ornamental, medicinal and aromatic plants and pests in polyhouses/protected cultivation.

UNIT VIII
Introduction, history of storage entomology, concepts of storage
entomology and significance of insect pests. Post-harvest losses in toto vis-à-vis total production of food grains in India. Scientific and socio-economic factors responsible for grain losses.

UNIT IX
Important pests namely insects, mites, rodents, birds and microorganisms associated with stored grain and field conditions including agricultural products; traditional storage structures; association of stored grain insects with fungi and mites, their systematic position, identification, distribution, host range, biology, nature and extent of damage, role of field and cross infestations and natural enemies, type of losses in stored grains and their effect on quality including biochemical changes.

UNIT X
Ecology of insect pests of stored commodities/grains with special emphasis on role of moisture, temperature and humidity in safe storage of food grains and commodities. Stored grain deterioration process, physical and biochemical changes and consequences. Grain storage- types of storage structures i.e., traditional, improved and modern storage structures in current usage. Ideal seeds and commodities’ storage conditions.

UNIT XI
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 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.

Practical
Field visits, collection and identification of important pests and their natural enemies; detection and estimation of infestation and losses in different crops; study of life history of important insect pests and non-insect pest. Collection, identification and familiarization with the stored grains/seed insect pests and nature of damage caused by them; detection of insect infestation in stored food grains; estimation of losses in stored food grains; determination of moisture content in stored food grains; familiarization of storage structures, demonstration of preventive and curative measures including fumigation techniques; treatment of packing materials and their effect on seed quality. Field visits to save grain campaign, central warehouse and FCI warehouses and institutions engaged in research or practice of grain storage like CFTRI, IGSMRI, Hapur etc. (only where logistically feasible).

Suggested Readings

**ENT 511 INSECT VECTORS OF PLANT VIRUSES AND 1+0 OTHER PATHOGENS**

**Theory**

**UNIT I**

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.

**UNIT II**

Transmission of plant viruses and fungal pathogens. Relation between viruses and their vectors.

**UNIT III**

Transmission of plant viruses by aphids, whiteflies, mealy bugs and thrips.

**UNIT IV**

Transmission of mycoplasm and bacteria by leaf hoppers and plant hoppers.

**UNIT V**

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, nematodes; culturing and handling of vectors; demonstration of virus transmission through vectors - aphids, leafhoppers and whiteflies.

**Suggested Readings**

**ENT 512 COMMERCIAL ENTOMOLOGY 1+1**

**Theory**

**UNIT I**

**UNIT II**
Study of different species of silkworms, characteristic features, moriculture, silk and its uses, pests and diseases of silkworms, rearing and management of silkworms. Lac insect- natural enemies and their management.

**UNIT III**
Economic and public health importance of insect pests in human habitation and habitats, biology, damage and control of mosquitoes, houseflies, bed bugs, ants, termites, cockroaches, flies, silverfish, head and body lice, carpet beetles, cloth moths, crickets, wasps, house dust mites, insect pests of cattle, poultry, pet animals and their management.

**UNIT IV**

**Practical**
Assessing pest status in dwellings (labs, canteen or hostel), implementation of pest control against flies, mosquitoes, bed bugs, cockroaches and rodents. Pre- and post-construction termite proofing methods, control of silverfishes in the library. Visit to poultry units and assessing pest status in poultries. Evaluation of commercially available domestic insect pest control products through bioassays. 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.

**Suggested Readings**


**ENT 601 IMMATURE STAGES OF INSECTS 1+1**

**Theory**

UNIT I

Types of immature stages in insect orders, morphology of egg, nymph/larva and pupa, identification of different immature stages of crop pests and stored product insects

UNIT II

Comparative study of life history strategies in hemi-metabola and holometabola, immature stages as ecological and evolutionary adaptations, significance of immature stages for pest management.

**Practical**

Types of immature stages; their collection, rearing and preservation. Identification of immature insects to orders and families, in endopterygote orders viz., Diptera, Lepidoptera, Hymenoptera and Coleoptera using key.

**Suggested Readings**


**ENT 602 INSECT BEHAVIOUR 1+1**

**Theory**

UNIT I

Defining Behaviour- Concept of umwelt, instinct, fixed action patterns, imprinting, complex behaviour, inducted behaviour, learnt behaviour and motivation. History of Ethology- development of behaviorism and ethology, contribution of Darwin, Frisch, Tinbergen and Lorenz; Studying behaviour- Proximate and Ultimate approaches, behavioural traits under natural selection, genetic control of behaviour and behavioural polymorphism.

UNIT II

Orientation- Forms of primary and secondary orientation including taxes and kinesis; Communication- primary and secondary orientation, responses to environmental stimuli, role of visual, olfactory and auditory signals in inter- and intra-specific communication, use of signals in defense, mimicry, polyphenism; evolution of signals.

UNIT III

Reproductive behaviour- mate finding, courtship, territoriality, parental care, parental investment, sexual selection and evolution of sex ratios; Social behaviour- kin selection, parental manipulation and mutualism; Selforganization
and insect behaviour.

UNIT IV
Foraging- Role of different signals in host searching (plant and insects) and host acceptance, ovipositional behaviour, pollination behaviour, coevolution of plants and insect pollinators. Behaviour in IPM- Concept of super-normal stimuli and behavioural manipulation as potential tool in pest management, use of semio-chemicals, auditory stimuli and visual signals in pest management.

Practical
Quantitative methods in sampling behaviour; training bees to artificial feeders; sensory adaptation and habituation in a fly or butterfly model, physical cues used in host selection in a phytophagous insect, chemical and odour cues in host selection in phytophagous insect (DBM or gram pod borer), colour discrimination in honey bee or butterfly model, learning and memory in bees, role of self-organization in resource tracking by honeybees. Evaluation of different types of traps against fruit flies with respect to signals; Use of honey bees/ Helicoverpa armigera to understand behavioural polymorphism with respect to learning and response to pheromone mixtures, respectively.

Suggested Readings

ENT 603 RECENT TRENDS IN BIOLOGICAL CONTROL 1+1
Theory
UNIT I
Scope of classical biological control and augmentative biocontrol; introduction and handling of natural enemies; nutrition of entomophagous insects and their hosts, dynamics of biocontrol agents vis-à-vis target pest populations.
UNIT II
Mass culturing techniques, insectary facilities and equipments, basic standards of insectary, viable mass-production unit, designs, precautions, good insectary practices.
UNIT III
Colonization, techniques of release of natural enemies, recovery evaluation, conservation and augmentation of natural enemies, survivorship analysis and ecological manipulations, large-scale production of biocontrol agents, bankable project preparation.
UNIT IV
Scope of genetically engineered microbes and parasitoids in biological control, genetics of ideal traits in biocontrol agents for introgressing and for progeny selections, breeding techniques of biocontrol agents.

Practical
Mass rearing and release of some commonly occurring indigenous natural enemies; assessment of role of natural enemies in reducing pest populations; testing side effects of pesticides on natural enemies; effect of semiochemicals on natural enemies, breeding of various biocontrol agents, performance of efficiency analyses on target pests; project document preparation for establishing a viable mass-production unit /insectary.

Suggested Readings

ENT 604 ADVANCED INSECTICIDE TOXICOLOGY 2+1

Theory
UNIT I
Penetration and distribution of insecticides in insect systems; insecticide selectivity; factors affecting toxicity of insecticides.

UNIT II
Biochemical and physiological target sites of insecticides in insects; developments in biorationals, biopesticides and newer molecules; their modes of action and structural – activity relationships; advances in metabolism of insecticides.

UNIT III
Joint action of insecticides; activation, synergism and potentiation.

UNIT IV
Problems associated with pesticide use in agriculture: pesticide resistance/resistance mechanisms and resistant management strategies; pest resurgence and outbreaks; persistence and pollution; health hazards and other side effects.

UNIT V
Estimation of insecticidal residues- sampling, extraction, clean-up and estimation by various methods; maximum residue limits (MRLs) and their fixation; insecticide laws and standards, and good agricultural practices.

Practical
Sampling, extraction, clean-up and estimation of insecticide residues by various methods; calculations and interpretation of data; biochemical and biological techniques for detection of insecticide resistance in insects.

Suggested Readings
**ENT 605 ADVANCED HOST PLANT RESISTANCE 1+1**

**Theory**

UNIT I
Importance of plant resistance, historical perspective, desirable morphological, anatomical and biochemical adaptations of resistance; assembly of plant species - gene pool; insect sources – behaviour in relation to host plant factors.

UNIT II
Physical and chemical environment conferring resistance in plants, role of trypsin inhibitors and protease inhibitors in plant resistance; biochemistry of induced resistance – signal transduction pathways, methyl jasmonate pathways, polyphenol oxidase pathways, salicylic acid pathways; effects of induced resistance; exogenous application of elicitors.

UNIT III
Biotechnological approaches in host plant resistance- genetic manipulation of secondary plant substances; incorporation of resistant gene in crop varieties; marker-aided selection in resistance breeding.

UNIT IV
Estimation of plant resistance based on plant damage- screening and damage rating; evaluation based on insect responses; techniques and determination of categories of plant resistance; breakdown of resistance in crop varieties.

**Practical**
Understanding mechanisms of resistance for orientation, feeding, oviposition etc., allelochemical bases of insect resistance; macroculturting of test insects like aphids, leaf/plant hoppers, mites and stored grain pests; field screening- microplot techniques, infester row technique, spreader row technique and plant nurseries; determination of antixenosis index, antibiosis index, tolerance index, plant resistance index.

**Suggested Readings**


ENT 606 ADVANCED ACAROLOGY 1+1

**Theory**

**UNIT I**
Comparative morphology of Acari, phylogeny of higher categories in mites, knowledge of commonly occurring orders and families of Acari in India. Diagnostic characteristics of commonly occurring species from families Tetranychidae, Tenuipalpidae, Eriophyidae, Tarsonemidae, Phytoseiidae, Bdellidae, Cunaxidae, Stigmaeidae, Pymotidae, Cheyletidae, Acaridae, Pyroglyphidae, Orthogalumnidae, Argasidae, Ixodidae, Sarcoptidae. Soil mites in India.

**UNIT II**
Management of economical important species of mites in agriculture, veterinary and public health; storage acarology.

**UNIT III**
Mites as vectors of plant pathogens; mode of action, structure-activity relationships of different groups of acaricides; problem of pesticide resistance in mites, resurgence of mites.

**UNIT IV**
Predatory mites, their mass production and utilization in managing mite pests, acaropathogenic fungi- identification, isolation and utilization.

**Practical**
Identification of commonly occurring mites up to species, preparation of keys for identification. Collection of specific groups of mites and preparing their identification keys. Rearing phytoseiid mites and studying their role in suppression of spider mites. Management of mite pests of crops using acaricides, phytoseiid predators, fungal pathogens etc.

**Suggested Readings**

ENT 607 MOLECULAR APPROACHES IN ENTOMOLOGICAL 1+1 RESEARCH

**Theory**

**UNIT I**
Introduction to molecular biology; techniques used in molecular biology.

**UNIT II**
DNA and RNA analysis in insects- transcription and translocation mechanisms. DNA recombinant technology, identification of genes/nucleotide sequences for characters of interest. Genetic improvement of natural enemies. Cell lines, genetic engineering in baculoviruses, Bt and
entomopathogenic fungi.

UNIT III
Genes of interest in entomological research- marker genes for sex identification, neuropeptides, JH esterase, St toxins and venoms, chitinase, CPTI; lectins and proteases. Peptides and neuropeptides, JH esterase, St toxins and venoms, chitinase, Bt toxin, CPTI; trypsin inhibitors, lectins and proteases, neuropeptides. Transgenic plants for pest resistance and diseases.

UNIT IV
Insect gene transformation; biotechnology in relation to silkworms and honey bees; introduction of lectin genes for pest suppression; DNA fingerprinting for taxonomy and phylogeny. Genetic improvement of inebriate tolerance of natural enemies.

UNIT V
DNA-based diagnostics; insect immune systems in comparison to vertebrates; molecular basis of metamorphosis; Sf transgenic technology and implications; molecular biology of baculoviruses; insecticide resistance. Resistance management strategies in transgenic crops.

Practical
Isolation of DNA/RNA; purity determinations; base pair estimation; agarose gel electrophoresis; restriction mapping of DNA; demonstration of PCR, RFLP and RAPD techniques.

Suggested Readings

ENT 608 ADVANCED INTEGRATED PEST MANAGEMENT 2+0

Theory
UNIT I
Principles of sampling and surveillance; database management and computer programming, simulation techniques and system analysis and modeling.

UNIT II
Case histories of national and international programmes, their implementation, adoption and criticisms, global trade and risk of invasive pests.

UNIT III
Genetic engineering and new technologies- their progress and limitations in IPM programmes, deployment of benevolent alien genes for pest management- case studies; scope and limitations of bio-intensive and
ecological based IPM programmes. Application of IPM to farmers’ realtime situations.

UNIT IV
Challenges, needs and future outlook: dynamism of IPM under changing cropping systems and climate; insect pest management under protected cultivation; strategies for pesticide resistance management.

**Suggested Readings**

**ENTOMOLOGY**

**List of Journals**
- *Agricultural and Forest Entomology* - Royal Entomological Society, UK
- *Annual Review of Entomology* - Paloatto, California, USA
- *Biopesticides International* - Koul Research Foundation, Jalandhar
- *Bulletin of Grain Technology* - Food Grain Technologist Res. Association of India, Hapur
- *Crop Protection* - Elsevier’s Science, USA
- *Ecological Entomology* - Royal Entomological Society, UK
- *Entomon* - Association for Advancement of Entomology, Kerala
- *Environmental Entomology* - Entomological Society of America, Maryland, USA
- *Indian Journal of Applied Entomology* - Entomological Research Association, Udaipur
- *Indian Journal of Entomology* - Entomological Society of India, New Delhi
- *Indian Journal of Plant Protection* - Plant Protection Society of India, Hyderabad
- *Indian Journal of Sericulture* - Central Silk Board, Bangalore
- **International Journal of Acarology**- Indira Acarology Publishing House, Minessota, USA
- **International Journal of Pest Management-** Taylor and Francis, UK
- **Journal of Acarology-** Acarological Society of India, UAS, Bangalore
- **Journal of Apiculture Research-** IBRA, UK
- **Journal of Biocontrol-** Society for Biocontrol Advancement, Bangalore
- **Journal of Economic Entomology-** Entomological Society of America, Maryland, USA
- **Journal of Entomological Research-** Malhotra Publishing House, New Delhi
- **Journal of Insect Behaviour-** Plenum Publishing Corporation, NY, USA
- **Journal of Insect Physiology-** Pergamon Press, UK
- **Journal of Insect Science-** Indian Society for the Advancement of Insect Science, Ludhiana
- **Journal of Invertebrate Pathology,** Elsevier Publ. Corporation, The Netherlands
- **Journal of Soil Biology and Ecology,** Indian Society of Soil Biology and Ecology, UAS, Bangalore
- **Journal of Stored Products Research-** Elsevier’s Science, USA
- **Pesticides Research Journal-** Society of Pesticides Science, New Delhi
- **Pesticide Science –** Oxford, London
- **Pesticide Biochemistry and Physiology-** New York, USA
- **Physiological Entomology-** Royal Entomological Society, UK
- **Systematic Entomology-** Royal Entomological Society, UK

**e-Resources**
- [http://www.colostate.edu/Depts/Entomology/](http://www.colostate.edu/Depts/Entomology/)
- [http://www.ent.iastate.edu/list/](http://www.ent.iastate.edu/list/)
- [http://www.biologybrowser.org/](http://www.biologybrowser.org/)
- [http://entomology.si.edu/](http://entomology.si.edu/)
- [http://www.intute.ac.uk/healthandlifesciences/agriculture/](http://www.intute.ac.uk/healthandlifesciences/agriculture/)
- [http://www.gbif.org/](http://www.gbif.org/)
- [http://www.mosquito.org/](http://www.mosquito.org/)
- [http://www.nysaes.cornell.edu/fst/faculty/acree/pheronet/index.html](http://www.nysaes.cornell.edu/fst/faculty/acree/pheronet/index.html)
- [http://www.ent.iastate.edu/list/](http://www.ent.iastate.edu/list/)
- [http://www.IPMnet.org/DIR/](http://www.IPMnet.org/DIR/)
- [http://www.nhm.ac.uk/hosted_sites/acarology/](http://www.nhm.ac.uk/hosted_sites/acarology/)
- [http://ars-genome.cornell.edu/](http://ars-genome.cornell.edu/)
- [http://www.tulane.edu/~dmsander/garryfavweb.html](http://www.tulane.edu/~dmsander/garryfavweb.html)
- [http://www.ufsia.ac.be/Arachnology/Arachnology.html](http://www.ufsia.ac.be/Arachnology/Arachnology.html)
- [http://http://ippc.orst.edu/IPMdefinitions/home.html](http://ippc.orst.edu/IPMdefinitions/home.html)
- [http://http://ent.iastate.edu/list/](http://http://ent.iastate.edu/list/)
- [http://ipmwww.ncsu.edu/cicp/IPMnet_NEWS/archives.html](http://ipmwww.ncsu.edu/cicp/IPMnet_NEWS/archives.html)
Suggested Broad Topics for Master’s and Doctoral Research

- Strengthening of eco-friendly strategies of integrated insect and mite pest management including:
  - Biological control
  - Bio-rational pesticides
  - Host plant resistance
  - Transgenic crop protection
  - Judicious use of pesticides
  - Molecular biosystematics
- Investigations on ecological factors including:
  - Survey and surveillance of insect and mite pests
  - Forecasting of insect and mite pest population life-tables and predictive models
  - Insect and mite biology
  - Population dynamics as influenced by abiotic and biotic factors
  - Studies on role of pollination including honeybees in increasing crop yields and production of honey and other allied products and management of honeybee diseases and mites
- Pesticide resistance and Insecticide Resistance Management strategies
- Biotypes of pests
- Below ground biodiversity- Bio-indicator of soil health, role in decomposition of litter, soil physico-chemical properties
- Bioprospecting for protocols, peptides, genes, insecticidal proteins and antibiotics
- Climate change and pests
- IPM in protected cultivation
- Location specific IPM strategies in different cropping systems
- Genetic improvement of natural enemies
- Genetic improvement of silkworms
- Refinement of silkworm rearing technology for different regions
- Management of silkworm pests and diseases
- Crop-pest modeling
- Insect biochemistry- pheromones, hormones and neuropeptides
- Insect physiology- metabolism and regulatory mechanisms.
- Indigenous technology
- Plants as sources of insecticides
- Molecular systematics – finger printing of species
- Insect systematics and phylogeny