### Courses for B. Sc. (Hons.) Agriculture

#### 2nd Semester

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Name of Course</th>
<th>Course No.</th>
<th>Cr. Hr.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Fundamentals of Entomology</td>
<td>ENTO 121</td>
<td>3(2+1)</td>
</tr>
</tbody>
</table>

#### 3rd Semester

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Name of Course</th>
<th>Course No.</th>
<th>Cr. Hr.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Introductory Nematology</td>
<td>ENTO 211</td>
<td>2(1+1)</td>
</tr>
</tbody>
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#### 4th Semester

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Name of Course</th>
<th>Course No.</th>
<th>Cr. Hr.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Insect Ecology and integrated Pest Management</td>
<td>ENTO 221</td>
<td>2(1+1)</td>
</tr>
</tbody>
</table>

#### 5th Semester

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Name of Course</th>
<th>Course No.</th>
<th>Cr. Hr.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Pests of Crops and Stored Grain and their Management</td>
<td>ENTO 311</td>
<td>3(2+1)</td>
</tr>
<tr>
<td>2.</td>
<td>Biopesticide &amp; Biofertilizers</td>
<td>ENTO 312</td>
<td>3(2+1)</td>
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</table>

#### 6th Semester

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Name of Course</th>
<th>Course No.</th>
<th>Cr. Hr.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Management of Beneficial Insects</td>
<td>ENTO 321</td>
<td>2(1+1)</td>
</tr>
</tbody>
</table>

#### 7th Semester

Modules for Skill Development and Entrepreneurship: A student has to register 20 credits opting for two modules of (0+10) credits each (Total 20 credits) from the package of modules in the VII semester.

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Activities</th>
<th>Credit Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Plant Clinic</td>
<td>10 (0+10)</td>
</tr>
<tr>
<td>2.</td>
<td>Beekeping</td>
<td>10 (0+10)</td>
</tr>
</tbody>
</table>

#### 8th Semester

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Title of the module</th>
<th>Credits</th>
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</thead>
<tbody>
<tr>
<td>1.</td>
<td>Orientation (RAWE)</td>
<td>-</td>
</tr>
<tr>
<td>2.</td>
<td>Plant Clinic (RAWE)</td>
<td>-</td>
</tr>
</tbody>
</table>

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### CERTIFICATE COURSE IN BEEKEEPING

- **Training Course**: Beekeeping  
- **Venue of training**: Division of Entomology, SKUAST-J, Chatha, Jammu  
- **Duration of the course**: 3 months (March to May)  
- **Target groups**: Unemployed youth, rural people, Private individual and
Eligibility:
Minimum qualification of 8th Pass

Registration fee:
Rs. 2000/- (Rupees Two thousand only)

Course programmer:
Dr. Hafeez Ahmad, Professor and Head, Division of Entomology

Course Coordinator:
Dr. Devinder Sharma, Assistant Professor, Division of Entomology

BAE & BHE COURSES TAUGHT BY ENTOMOLOGY

BAE-05 : INSECT PESTS OF FIELD CROPS AND THEIR MANAGEMENT (1+1)
Theory:
Distribution, biology, nature and symptoms of damage, and management strategies of insect and non insect pests of cereals (rice, sorghum, maize, ragi, wheat), Distribution, biology, nature and symptoms of damage, and management strategies of insect and non insect pests of sugarcane, Distribution, biology, nature and symptoms of damage, and management strategies of insect and non insect pests of cotton, mesta, sunhemp, Distribution, biology, nature and symptoms of damage, and management strategies of insect and non insect pests of pulses, Distribution, biology, nature and symptoms of damage, and management strategies of insect and non insect pests of oilseeds (groundnut, castor, gingelly, safflower, sunflower, mustard), Distribution, biology, nature and symptoms of damage, and management strategies of insect and non insect pests of vegetable crops.

Practicals:
Identification of pests and their damage symptoms of important insect pests of cereals, pulses, oilseeds, fibre crops, Identification of pests and their damage symptoms of important insect pests of vegetable crops, Identification of pests and their damage symptoms of important insect pests of vegetable crops, Collection of insect pest and damaged material (Insectarium).

BHE-05 : INSECT PESTS OF FRUIT CROPS AND THEIR MANAGEMENT (1+1)
Theory:
Distribution, biology, nature and symptoms of damage, and management strategies of insect and non insect pests of Apple, pear, peach, litchi, plum, cherry, almond, walnuts, pomegranate, mango, guava, aonla, ber, citrus etc.

Practicals:
Identification and collection of insect pests and damaged material, Identification of pests and their damage symptoms of major pests of important crops.

BAE-08 APICULTURE (1+2)

Theory
History of beekeeping in India and world, Importance and Scope of beekeeping, Honeybee species, Colony organization of honeybees, Bee behaviour (Swarming, Absconding, Robbing), Beekeeping equipments, Seasonal management, Migratory beekeeping, Bee products, Bee pasturage/bee forage, Role of honeybee in crop pollination, Diseases and enemies of bees

Practical
Hive inspection, Acquaintance with beekeeping equipments, Field visits
COURSE REQUIREMENT:
- Major 20 (12-15 credits should be compulsory rest optional),
- Minor 9
- Supporting 5
- Seminar 1
- Research 20 (as per 9th academic council meeting 2009)

Field of Specialization: Economic Entomology, IPM, Toxicology, Apiculture, Nematology

<table>
<thead>
<tr>
<th>COURSE NO.</th>
<th>COURSE TITLE</th>
<th>CREDITS</th>
<th>SEMESTER</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Compulsory Courses</strong></td>
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</tr>
<tr>
<td>ENTO 501</td>
<td>Insect Morphology</td>
<td>1+1</td>
<td>I</td>
</tr>
<tr>
<td>ENTO 502</td>
<td>Insect Anatomy, Physiology And Nutrition</td>
<td>2+1</td>
<td>I</td>
</tr>
<tr>
<td>ENTO 503</td>
<td>Classification of Insects</td>
<td>2+1</td>
<td>I</td>
</tr>
<tr>
<td>ENTO 504</td>
<td>Insect Ecology</td>
<td>1+1</td>
<td>I</td>
</tr>
<tr>
<td>ENTO 505</td>
<td>Toxicology of Insecticides</td>
<td>2+1</td>
<td>II</td>
</tr>
<tr>
<td>ENTO 506</td>
<td>Principles of Integrated Pest Management</td>
<td>1+1</td>
<td>II</td>
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<tr>
<td><strong>Total</strong></td>
<td></td>
<td>9+6 = 15</td>
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<tr>
<td><strong>Optional Courses</strong></td>
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<tr>
<td>ENTO 507</td>
<td>Principles of Taxonomy</td>
<td>2+0</td>
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<tr>
<td>ENTO 508</td>
<td>Insect Pathology</td>
<td>1+1</td>
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<tr>
<td>ENTO 509</td>
<td>Biological Control of Crop Pests and Weeds</td>
<td>1+1</td>
<td>II</td>
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<tr>
<td>ENTO 510</td>
<td>Plant Resistance to Insects</td>
<td>1+1</td>
<td>II</td>
</tr>
<tr>
<td>ENTO 511</td>
<td>Pests of Field Crops</td>
<td>1+1</td>
<td>II</td>
</tr>
<tr>
<td>ENTO 512</td>
<td>Pests of Horticultural and Plantation Crops</td>
<td>1+1</td>
<td>II</td>
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<tr>
<td>ENTO 513</td>
<td>Storage Entomology</td>
<td>1+1</td>
<td>I</td>
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<tr>
<td>ENTO 514</td>
<td>Insect Vectors of Plant Viruses and other Pathogens</td>
<td>1+1</td>
<td>II</td>
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<tr>
<td>ENTO 515</td>
<td>General Acarology</td>
<td>1+1</td>
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</tr>
<tr>
<td>ENTO 516</td>
<td>Soil Arthropods and their Management</td>
<td>1+1</td>
<td>I</td>
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<tr>
<td>ENTO 517</td>
<td>Vertebrate Pest Management</td>
<td>1+1</td>
<td>I</td>
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<tr>
<td>ENTO 518</td>
<td>Techniques in Plant Protection</td>
<td>0+1</td>
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<tr>
<td>ENTO 519</td>
<td>Commercial Entomology</td>
<td>1+1</td>
<td>II</td>
</tr>
<tr>
<td>ENTO 520</td>
<td>Plant Quarantine</td>
<td>2+0</td>
<td>II</td>
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<tr>
<td>ENTO 521</td>
<td>Principles of Nematology</td>
<td>2+1</td>
<td>I</td>
</tr>
<tr>
<td>ENTO 522</td>
<td>Nematode Diseases of Crops</td>
<td>3+1</td>
<td>I</td>
</tr>
<tr>
<td>ENTO 523</td>
<td>Nematode Interactions with other Organisms</td>
<td>2+1</td>
<td>II</td>
</tr>
<tr>
<td>ENTO 524</td>
<td>Nematode Management</td>
<td>2+1</td>
<td>II</td>
</tr>
<tr>
<td>ENTO 525</td>
<td>Beneficial Nematodes</td>
<td>1+1</td>
<td>II</td>
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<tr>
<td>ENTO 591</td>
<td>Master’s Seminar</td>
<td>1+0</td>
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<tr>
<td>ENTO 599</td>
<td>Master’s Research</td>
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</table>

**NOTE:** The student's advisory committee will decide rest of the courses for Minor and Supporting from the Plant Pathology, Vegetable Sciences & Floriculture, Fruit Science, Agricultural Statistics, Biochemistry and Plant Physiology, Genetics and Plant Breeding.
DIVISION OF ENTOMOLOGY
SKUAST-J, CHATHA

PROGRAMME: Ph. D. (Entomology)

COURSE REQUIREMENT:
- Major 15 (9-12 core rest optional),
- Minor 8,
- Supporting 5,
- Seminar 2,
- Research 45 (as per 9th academic council meeting 2009)

Field of Specialization: Economic Entomology, IPM, Toxicology, Apiculture, Nematology

<table>
<thead>
<tr>
<th>COURSE NO.</th>
<th>COURSE TITLE</th>
<th>CREDITS</th>
<th>SEMESTER</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ento 601</td>
<td>Advanced Insect Ecology</td>
<td>1+1</td>
<td>I</td>
</tr>
<tr>
<td>Ento 602</td>
<td>Recent Trends in Biological Control</td>
<td>1+1</td>
<td>I</td>
</tr>
<tr>
<td>Ento 603</td>
<td>Advanced Integrated Pest Management</td>
<td>2+0</td>
<td>I</td>
</tr>
<tr>
<td>Ento 608</td>
<td>Advanced Insecticide Toxicology</td>
<td>2+1</td>
<td>II</td>
</tr>
<tr>
<td>Ento 606</td>
<td>Advanced Insect Physiology</td>
<td>2+0</td>
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Total 8+3 = 11

<table>
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<tr>
<th>COURSE NO.</th>
<th>COURSE TITLE</th>
<th>CREDITS</th>
<th>SEMESTER</th>
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<tbody>
<tr>
<td>Ento 604</td>
<td>Advanced Insect Systematics</td>
<td>1+2</td>
<td>I</td>
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<tr>
<td>Ento 605</td>
<td>Immature Stages of Insects</td>
<td>1+1</td>
<td>I</td>
</tr>
<tr>
<td>Ento 607</td>
<td>Insect Behaviour</td>
<td>1+1</td>
<td>II</td>
</tr>
<tr>
<td>Ento 609</td>
<td>Advanced Host Plant Resistance</td>
<td>1+1</td>
<td>II</td>
</tr>
<tr>
<td>Ento 610</td>
<td>Advanced Acarology</td>
<td>1+1</td>
<td>II</td>
</tr>
<tr>
<td>Ento 611</td>
<td>Agricultural Ornithology</td>
<td>1+1</td>
<td>I</td>
</tr>
<tr>
<td>Ento 612</td>
<td>Molecular Approaches in Entomological Research</td>
<td>1+1</td>
<td>II</td>
</tr>
<tr>
<td>Ento 613</td>
<td>Current Topics in Nematode Disease Development and Host Resistance</td>
<td>2+1</td>
<td>II</td>
</tr>
<tr>
<td>Ento 614</td>
<td>Advances in Nematode Management</td>
<td>2+1</td>
<td>I</td>
</tr>
<tr>
<td>Ento 691</td>
<td>Doctoral Seminar I</td>
<td>1+0</td>
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<tr>
<td>Ento 692</td>
<td>Doctoral Seminar II</td>
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</tr>
<tr>
<td>Ento 699</td>
<td>Doctoral Research</td>
<td>45</td>
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</tbody>
</table>

NOTE: The student’s advisory committee will decide rest of the courses for Minor and Supporting from the Plant Pathology, Vegetable Sciences & Floriculture, Fruit Science, Agricultural Statistics, Biochemistry and Plant Physiology, Genetics and Plant Breeding.
ENTOMOLOGY
M. Sc. Course Contents

**ENTO 501   INSECT MORPHOLOGY  1+1   Sem- I**

**Objective**
To acquaint the students with external morphology of the insect’s body i.e., head, thorax and abdomen, their appendages and functions.

**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**

**ENTO 502   INSECT ANATOMY, PHYSIOLOGY AND NUTRITION  2+1   Sem- I**

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

**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

ENTO 503 CLASSIFICATION OF INSECTS 2+1 Sem- I

Objective
To introduce the students to the classification of insects up to the level of families with hands-on experience in identifying the families of insects.

Theory
UNIT I
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 II

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

Practical

Suggested Readings
ENTO 504 INSECT ECOLOGY 1+1 Sem- I

Objective

To teach the students the concepts of ecology, basic principles of distribution and abundance of organisms and their causes. Study life tables, organization of communities, diversity indices. Train students in sampling methodology, calculation of diversity indices, constructing life tables, relating insect population fluctuations to biotic and/or abiotic causes.

Theory

UNIT I


UNIT II


UNIT III


UNIT IV


Practical

Types of distributions of organisms. Methods of sampling insects, estimation of densities of insects and understanding the distribution parameters- Measures of central tendencies, Poisson Distribution, Negative Binomial Distribution. Determination of optimal sample size. Learning to fit basic population growth models and testing the goodness of fit. Fitting Holling’s Disc equation, Assessment of prey-predator densities from natural systems and understanding the correlation between the two. Assessing and describing niche of some insects of a single guild. Calculation of niche breadth, activity breadth and diagrammatic representation of niches of organisms. Calculation of some diversity 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

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.

**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 pyrazoles, insect growth regulators, microbials, botanicals, 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**

**ENTO 506  PRINCIPLES OF INTEGRATED PEST MANAGEMENT  1+1  Sem- II**

**Objective**

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.

**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**


**ENTO 507  PRINCIPLES OF TAXONOMY  2+0  Sem- I**

**Objective**

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

**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

Suggested Readings

ENTO 508 INSECT PATHOLOGY 1+1
Objective
To teach the students about various microbes that are pathogenic to insects, factors that affect their virulence; provide hands-on training in identification, isolation, culturing various pathogens and assessing pathogenicity.

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

ENTO 509 BIOLOGICAL CONTROL OF CROP PESTS AND WEEDS 1+1 Sem- II
Objective
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.

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

ENTO 510 PLANT RESISTANCES TO INSECTS 1+1 Sem- II

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

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

ENTO 511 PESTS OF FIELD CROPS 1+1 Sem- II

Objective
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.

Theory
Systematic position, identification, distribution, host-range, bionomics, nature and extent of damage, seasonal abundance and management of insect and mite pests and vectors.

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.

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.

Suggested Readings

ENTO 512 PESTS OF HORTICULTURAL AND PLANTATION CROPS 1+1 Sem- II

Objective
To impart knowledge on major pests of horticultural and plantation crops regarding the extent and nature of loss, seasonal history, their integrated management.
Theory
Systematic position, identification, distribution, host range, bionomics and seasonal abundance, nature and extent of damage and management of insect pests of various crops.

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

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

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

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

Practical
Collection and identification of important pests and their natural enemies on different crops; study of life history of important insect pests and non-insect pests.

Suggested Readings

ENTO 513   STORAGE ENTOMOLOGY   1+1    Sem- I

Objective
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.

Theory

UNIT I
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 II
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 III
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 IV
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, disinfections 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
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).

Suggesting Readings

**ENTO 514 INSECT VECTORS OF PLANT VIRUSES AND OTHER PATHOGENS 1+1**

**Sem- II**

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

**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 mycoplasma 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**

**ENTO 515  GENERAL ACAROLOGY  1+1  Sem- I**

**Objective**
To acquaint 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.

**Theory**

**UNIT I**
History of Acarology; importance of mites as a group; habitat, collection and preservation of mites.

**UNIT II**
Introduction to morphology and biology of mites and ticks. Broad classification- major orders and important families of Acari including diagnostic characteristics.

**UNIT III**
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 of mites from plants, soil and animals; extraction of mites from soil, plants and stored 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.

**Suggested Readings**

**ENTO 516  SOIL ARTHROPODS AND THEIR MANAGEMENT  1+1  Sem- I**

**Objective**
To impart knowledge about the different groups of arthropods found in soil, interaction between the different groups, and role of soil arthropods in humus formation. Hands-on training in sampling and identification of different groups of soil arthropods.

**Theory**

**UNIT I**
Soil arthropods and their classification, habitats and their identification.

**UNIT II**
Estimation of populations; sampling and extraction methods.

**UNIT III**
Role of soil arthropods in detritus feeding, litter breakdown and humus formation. Soil arthropods as bio-indicators of habitat qualities. Effect of soil arthropod activity on soil properties.
UNIT IV
Harmful and beneficial soil arthropods and their management, interrelationship among arthropods and other soil invertebrates and soil microorganisms. Anthropogenic effects on soil arthropods.

Practical
Sampling, extraction methods and identification of various types of soil fauna; estimation and assessment of soil arthropod population; techniques and culturing soil invertebrates.

Suggested Readings

ENTO 517 VERTEBRATE PEST MANAGEMENT 1+1 Sem- I

Objective
To impart knowledge on vertebrate pests like birds, rodents, mammals etc., of different crops, their biology, damage they cause and management strategies.

Theory
UNIT I
Vertebrate pests of different crops; biology of vertebrate pests such as rodents, birds and other mammals. Biology of beneficial birds.
UNIT II
Population dynamics and assessment, patterns of pest damage and assessment, roosting and nesting systems in birds.
UNIT III
Management strategies- physical (trapping, acoustics and visual), chemical (poisons, repellents, fumigants and anticoagulants), biological (predators, parasites), cropping practices, alteration of habitats, diversion baiting and other eco-friendly methods- Operational practices- baiting, bioassays (LD50 studies), equipments and educative programmes.

Practical
Identification of important rodent and other vertebrate pests of agriculture, food preference and hoarding, social behaviour, damage assessment, field survey, population estimation, control operation and preventive methods.

Suggested Readings

ENTO 518 TECHNIQUES IN PLANT PROTECTION 0+1 Sem- I

Objective
To acquaint the students with appropriate use of plant protection equipments and techniques related to microscopy, computation, pest forecasting, electrophoresis etc.

Theory
UNIT I
Pest control equipments, principles, operation, maintenance, selection, application of pesticides and biocontrol agents, seed dressing, soaking, root-dip treatment, dusting, spraying, application through irrigation water.
UNIT II
Soil sterilization, solarization, deep ploughing, flooding, techniques to check the spread of pests through seed, bulbs, corns, cuttings and cut flowers.
UNIT III
Use of light, transmission and scanning electron microscopy.

UNIT IV
Protein isolation from the pest and host plant and its quantification using spectrophotometer and molecular weight determination using SDS/PAGE.

UNIT V
Use of tissue culture techniques in plant protection. Computer application for predicting/forecasting pest attack and identification.

Suggested Readings

ENTO 519    COMMERCIAL ENTOMOLOGY    1+1    Sem- II

Objective
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.

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

**ENTO 520  PLANT QUARANTINE  2+0  Sem- II**

**Objective**
To acquaint the learners about the principles and the role of Plant Quarantine in containment of pests and diseases, plant quarantine regulations and set-up.

**Theory**

**UNIT I**
Definition of pest, pesticides and transgenics as per Govt. notification; relative importance; quarantine – domestic and international. Quarantine restrictions in the movement of agricultural produce, seeds and planting material; case histories of exotic pests/diseases and their status.

**UNIT II**

**UNIT III**
Identification of pest/disease free areas; 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 disinestation/salvaging of infected material.

**UNIT IV**
WTO regulations; non-tariff barriers; Pest risk analysis, good laboratory practices for pesticide laboratories; pesticide industry; Sanitary and Phytosanitary measures.

**Suggested Readings**

**ENTO 521  PRINCIPLES OF NEMATOLOGY  2+1  Sem- I**

**Objective**
To project the importance of nematodes in agriculture and impart basic knowledge on all aspects of plant nematology.

**Theory**

**UNIT I**
History and growth of Nematology; nematode habitats and diversity- plant, animal and human parasites; useful nematodes; economic importance of nematodes to agriculture, horticulture and forestry.

**UNIT II**
Gross morphology of plant parasitic nematodes; broad classification, nematode biology, physiology and ecology.

**UNIT III**
Types of parasitism; nature of damage and general symptomatology; interaction of plant parasitic nematodes with other organisms.

**UNIT IV**
Plant nematode relationships, cellular responses to infection by important phytonematodes; physiological specialization among phytonematodes.

**UNIT V**
Principles and practices of nematode management; integrated nematode management.

**Practical**
Studies on kinds of nematodes- free-living, animal, insect and plant parasites; nematode extraction from soil; extraction of migratory endoparasites, staining for sedentary endoparasites; examination of
different life stages of important plant parasitic nematodes, their symptoms and histopathology.

Suggested Readings

UNIT II
Interaction of plant parasitic nematodes with wilt causing fungal pathogens.

UNIT III
Interaction of plant parasitic nematodes with root rot and other fungal pathogens.

UNIT IV
Interaction of plant parasitic nematodes with bacterial pathogens, other nematode species and arthropods.

UNIT V
Virus transmission by nematodes.

Practical
Green-house experiments to study the role of plant parasitic nematodes in wilt/rot causing fungal and bacterial pathogens.

Suggested Readings

ENTO 524 NEMATODE MANAGEMENT 2+1 Sem- II

Objective
To impart comprehensive knowledge about the principles and practices of nematode management.

Theory
UNIT I
Concepts and history of nematode management; crop loss estimation, ecological and socio-economic aspects, cost-benefit ratios and pest risk analysis.

UNIT II
Chemical methods- nematicides, their types, classification, mode of action, applicators and application methods, antidotes, and economizing nematicidal use.

UNIT III
Cultural practices- crop rotations and cropping sequences, fallowing, flooding, soil solarisation, time of sowing, organic amendments of soil, biofumigation, antagonistic and trap crops, sanitation etc.

UNIT IV
Physical methods- use of heat, hot water treatment and other methods of disinfestations of planting material.

UNIT V
Biological methods- concepts and terminology, use of predators and parasites as biological control agents, their mass multiplication and field use; phytotherapeutic methods – use of antagonistic plants and antinemic plant products.

UNIT V
Genetic methods- plant resistance; legal methods- quarantine regulations; integrated nematode management-concepts and applications.

Practical
*In vitro* screening of synthetic chemicals and plant products for nematicidal activity, and their application methods; methods for screening of crop germplasm for resistance against nematodes, laboratory exercises on biocontrol potential of fungal, bacterial parasites, and predacious fungi and nematodes.

Suggested Readings

**ENTO 525**  **BENEFICIAL NEMATODES**  **1+1**  **Sem- II**

**Objective**
To sensitize about the use of nematodes for the biological control of insect pests of crops, and application of some nematodes as biological models and as indicators of environmental pollution.

**Theory**

**UNIT I**
Beneficial nematode fauna- predators, parasites of insects, molluscs and other pests; Entomophilic nematodes- important groups, types of nematode insect associations; taxonomic characteristics of nematode parasites of insects.

**UNIT II**
Host-parasite relations and life cycle of mermithids, entaphelenchids, thelastomids, sphaerularids and tylenchids.

**UNIT III**
Enteromopathogenic nematodes- *Steinernema* and *Heterorhabditis*, their morphological characteristics, taxonomic status, biology and mode of action.

**UNIT IV**
Enteromopathogenic nematodes- mass multiplication techniques, formulations, field applications and efficacy, success stories.

**UNIT V**
Nematodes as biological models, nematodes as indicators of pollution, role of nematodes in organic matter recycling.

**Practical**
Isolation, identification, mass rearing and application methods of entomopathogenic nematodes.

**Suggested Readings**

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**Ph. D Course Contents**

**ENTO 601**  **ADVANCED INSECT ECOLOGY**  **1+1**  **Sem- I**

**Objective**
To impart advanced practical knowledge of causal factors governing the distribution and abundance of insects and the evolution of ecological characteristics.

**Theory**

**UNIT I**

**UNIT II**


UNIT III

UNIT IV
Reproductive ecology- Sexual selection, Mating systems, Reproductive strategies - timing, egg number, reproductive effort, sibling rivalry and parent-offspring conflict. Agro-ecological vs Natural Ecosystems – Characterisation, Pest Control as applied ecology- case studies.

Practical

Suggested Readings

ENTO 602 RECENT TRENDS IN BIOLOGICAL CONTROL 1+1 Sem- I

Objective
To appraise the students with advanced techniques in handling of different bioagents, modern methods of biological control and scope in cropping system-based pest management in agro-ecosystems.

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

ENTO 603 ADVANCED INTEGRATED PEST MANAGEMENT 2+0 Sem- I
Objective
To acquaint the students with recent concepts of integrated pest management. Surveillance and data base management. Successful national and international case histories of integrated pest management, non conventional tools in pest management.

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


**ENTO 604   ADVANCED INSECT SYSTEMATICS   1+2   Sem- I**

**Objective**

To familiarize the students with different schools of classification, phylogenetics, classical and molecular methods, evolution of different groups of insects. International Code of Zoological Nomenclature. Ethics and procedure for taxonomic publications.

**Theory**

**UNIT I**


**UNIT II**


**UNIT III**

Detailed study of International Code of Zoological Nomenclature, including appendices to ICZN- Ethics.

**UNIT IV**

Concept of Phylocode and alternative naming systems for animals. A detailed study of selected representatives of taxonomic publications – small publications of species descriptions, revisionary works, monographs, check lists, faunal volumes, etc. Websites related to insect taxonomy and databases. Molecular Taxonomy, barcoding species.

**Practical**

Collection, curation and study of one taxon of insects- literature search, compilation of a checklist, study of characters, development of character table, construction of taxonomic keys for the selected group. Development of descriptions, photographing, writing diagrams, and preparation of specimens for “type like” preservation. Submission of the collections made of the group. Multivariate Analysis techniques for clustering specimens into different taxa, and development of phenograms. Rooting and character polarisation for developing cladograms and use of computer programmes to develop cladograms.

**Suggested Readings**


**ENTO 605 IMMATURE STAGES OF INSECTS 1+1 Sem- I**

**Objective**

To impart knowledge on morphology of immature stages of different groups of insects. Train students in identification of common pest species during their immature stages.

**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 endopterygotes orders viz., Diptera, Lepidoptera, Hymenoptera and Coleoptera using key.

**Suggested Readings**


**ENT 606 ADVANCED INSECT PHYSIOLOGY 2+0 Sem- I**

**Objective**

To impart knowledge to the students on detailed physiology of various secretory and excretory systems, moulting process, chitin synthesis, physiology of digestion, transmission of nerve impulses, nutrition of insects, pheromones etc.

**Theory**

**UNIT I**
Physiology and biochemistry of insect cuticle and moulting process. Biosynthesis of chitin, chitin-protein interactions in various cuticles, types of sclerotization.

**UNIT II**
Digestive enzymes, digestive physiology in phytophagous, wood boring and wool feeding insects, efficiency of digestion and absorption, role of endosymbionts in insect nutrition, nutritional effects on growth and development; physiology of excretion and osmoregulation, water conservation mechanisms.

**UNIT III**
Detailed physiology of nervous system, transmission of nerve impulses, neurotransmitters and modulators. Production of receptor potentials in different types of sensilla, pheromones and other semiochemicals in insect life, toxins and defense mechanisms.
UNIT IV
Endocrine system and insect hormones, physiology of insect growth and development—metamorphosis, polyphenism and diapause. Energetics of muscle contractions.

Suggested Readings

**Objective**
To acquaint the students with a thorough understanding of how natural selection has led to various survival strategies manifested as behaviour in insects.

**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; Self-organization 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 semiochemicals, 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**

**ENTO 608  ADVANCED INSECTICIDE TOXICOLOGY  2+1  Sem- II**

**Objective**
To acquaint the students with the latest advancements in the field of insecticide toxicology, biochemical and physiological target sites of insecticides, and pesticide resistance mechanisms in insects.

**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**

**ENTO 609  ADVANCED HOST PLANT RESISTANCE  1+1  Sem- II**

**Objective**
To familiarize the students with recent advances in resistance of plants to insects and acquaint with the techniques for assessment and evaluation of resistance in crop plants.

**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; macroculturing 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

ENTO 610  ADVANCED ACAROLOGY   1+1    Sem- II

Objective
To acquire a good working knowledge of identification of economically important groups of mites up to the species level, a detailed understanding of the newer acaricide molecules and utilization of predators.

Theory
UNIT I

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


ENTO 611 AGRICULTURAL ORNITHOLOGY 1+1 Sem- I

Objective

To expose the students to the prevalence of birds in agricultural fields, their habitat associations and the beneficial and harmful role played by birds in crop fields and management of pest situations.

Theory

UNIT I

Status of agricultural ornithology in India, groups of birds associated with agro-ecosystems. Habitat associations of birds in both wet and dry agricultural systems. Association of birds with different cultivation practices and crop stages, their seasonality and succession. Pestiferous and beneficial birds associated with different crops, their general biology and ecology. Food and feeding habits of birds in crop fields.

UNIT II


Practical

Study of different groups of birds associated with agriculture, their morphology and field identification. Field visits to different agroecosystems. Study of bird associations with different crop stages. Study of nesting and roosting habits of birds in agricultural habitats. Study of the feeding habits, nature and types of damage caused by birds in selected crops. Visits to godowns. Analysis and study of the use of bird excreta in agriculture at a bird sanctuary. Field visits to paddy growing command areas to study birds in crop fields. Assignments on assessing bird damage, estimation of populations etc.

Suggested Readings


ENTO 612 MOLECULAR APPROACHES IN ENTOMOLOGICAL RESEARCH 1+1 Sem- II

Objective

To familiarize the students with DNA recombitant technolgy, marker genes, transgenic plants, biotechnology in sericulture and apiculture.

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 finger printing 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

ENTO 613 CURRENT TOPICS IN NEMATODE DISEASE DEVELOPMENT AND HOST RESISTANCE

Objective
To update knowledge on the recent research trends in the field of plant nematode relationships at genetic and molecular level.

Theory
UNIT I
Mechanisms of pathogenesis, cytological and biochemical changes induced by nematode feeding.

UNIT II
Plant defense systems, role of phytoalexins etc. against major plant parasitic nematodes.

UNIT III
Genetic basis of plant resistance to nematodes and identification of resistance genes against economically important nematodes.

UNIT IV
Application of biotechnological methods in the development of nematode resistant crop cultivars; resistance markers; incorporation of resistance by conventional breeding and transgenic approaches.

UNIT V
Influence of microorganisms on plant nematode interactions.

Practical
Microtomy for study of histopathological changes induced by important nematodes, screening techniques for assessment of resistance in crop germplasm against nematodes.
Suggested Readings


ENTO 614 ADVANCES IN NEMATODE MANAGEMENT 2+1 Sem- I

Objective
To keep abreast with latest developments and trends in nematode management.

Theory
UNIT I
Isolation, identification, host specificity, mode of action, culturing and field application potential of promising bio-control agents- predacious and parasitic fungi; nematotoxic fungal culture filtrates.
UNIT II
Isolation, identification, host specificity, mode of action, culturing and field application potential of promising bio-control agents- parasitic and nematode antagonistic bacteria; predacious mites and predacious nematodes.
UNIT III
Mass culturing, formulation, quality control, bio-safety and registration protocols of bio-control agents.
UNIT IV
Phytoalexins, allelochemicals, phytotherapeutic substances, novel nematicides, deployment of resistant varieties and non-host crops in nematode suppressive cropping systems, emergence of resistance breaking biotypes, recent regulatory provisions and methods, quarantine and disinfection.
UNIT V
Nematode management modules for integrated pest and disease management in cropping systems. Nematode management options and approaches for organic farming and precision farming. Application of GIS and GPS technology for surveillance and management.

Practical
Green-house experiments on the efficacy of fungal and bacterial bio-control agents, botanicals.

Suggested Readings

7. Upadhyaya