

Entomology Course Structure

Semester 3

Course No.	Course Title	Nature of course	Credits	Full Marks
Ent 608	General Entomology	T	4	100
Ent 609	Taxonomy & Insect Pests	T	4	100
Ent 610	Pest Management	T	4	100
Ent 611	Medical & Industrial Entomology & Research Methodology II	T	4	100
Ent 612	General Entomology & Taxonomy	P	2	50
Ent 613	Pest Management, Med. & Ind. Entomology	P	2	50
Ent 614	Dissertation Proposal & Seminar		1	25
Total			21	525

Semester 4

Ent 653	Insect Ecology & Behaviour	T	3	75
Ent 654	Thesis		4	100
Total			7	175

Semester III

Entomology

Course Title: General Entomology

Credits: 4

Course No.: Ent 608

Lecture hrs: 60

Nature of the Course: Theory

Full Marks: 100

Pass Marks: 50

Course Objectives

- To make students able to understand habits and habitats, origin and evolution of insects.
- To acquaint students with insect structures, life processes and life cycle.

Course Contents

Introduction to Entomology: Understanding insects and their relatives (other arthropods). Habits and habitats of insects. Origin and Evolution of Insects. **6 hrs**

Morphology: Integument: Structure and functions, Cuticular modifications; Cuticle in moulting, ecdysis and sclerotization. Insect colouration. Head and segmentation, its appendages, antennae and mouthparts: their basic structure and modifications. Thorax and segmentation and its appendages: legs and wings and their basic structures and modifications, wing venation and its coupling. Abdomen and segmentation, appendages and genitalia (External and Internal). **20 hrs**

Anatomy and Physiology: Digestive system. Respiratory system. Excretory system. Circulatory system. Reproductive system, Sound and light producing organs. **16 hrs**

Insect Embryology and Endocrinology: Insect eggs, embryonic development, viviparity, polyembryony, parthenogenesis, pedogenesis and metamorphosis, types of larvae and pupae, Molting and Diapause physiology. Insect hormones: types, structure and functions. **18 hrs**

References

- Chapman, R.F. 1998. The insects structure and function 4th edition. Cambridge University Press.
- Comstock, J.H. 1984. An introduction to Entomology. 9th edition revised. Satish Book Enterprise Bookseller and publishers, Agra.
- Fox, R.M. and Fox, J.W. 1966. Introduction to comparative entomology. Reinhold Publishing Corporation, New York.
- Gillott, C. 1995. Entomology . 2nd Edition. Plenum Press, New York.
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- Klowden.M.J.2007. Physiological systems in insects: Academic Press, 2E edition. 688 pages.
- Patton, W.S. and Evans, A.M. 1929. General Textbook of Entomology Vol.I. Akashdeep Publishing House, New Delhi.
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- Richards, O.W. and Davies, R.G. 1977. Imm's general textbook of entomology. 10th edition vol. I Structure, physiology and Development, Chapman and Hall, London.
- Steinmann, H. and Zombori, L. 1981. An atlas of insect morphology. Akademiai Kiade.

Semester III

Entomology

Course Title: Taxonomy & Insect Pests

Credits: 4

Course No.: Ent 609

Lecture hrs: 60

Nature of the Course: Theory

Full Marks: 100

Pass Marks: 50

Course Objectives

- To acquaint students with taxonomic characters of insect orders and their classification.
- To familiarize students with beneficial and harmful insects particularly pests of major field crops, vegetables, fruits, other plants and stored grain pests, and their management tools
- To provide fundamental knowledge of biology, damage patterns and control measures of selected major insects pests.

Course Contents

Taxonomy: Principles of insect classification. Identifying, describing and naming species. Classification and family level identification of Apterygote insects ((Protura, Diplura Collembola* and Thysanura*)), Exopterygote insects (Ephemeroptera*, Odonata*, Blattodea, Mantodea, Isoptera, Dermaptera, Plecoptera*, Orthoptera,* Phasmatodea, Psocoptera, Hemiptera*, Thysanoptera) and Endopterygote insects (Megaloptera, Neuroptera, Siphonaptera, Coleoptera*, Diptera*, Lepidoptera*, Trichoptera*, Hymenoptera*). **30 hrs**

* Emphasis should be given particularly to these orders and their ecologically and economically important families reported in oriental region.

Insect pests

30 hrs

Biology, damage, and management of field crop insect pests (rice, maize, wheat, pulses, oil seed crops and cash crops).

Biology, damage, and management of major insect pests of vegetables (cruciferous plants, potato) and fruits (mango, litchi, guava, citrus, peach, pear, banana and apples).

Overview of insect pests of ornamental plants and medicinal plants.

Stored grain pests and their management. Biology and management of mites associated with crop plants and stored products. Assessment of post-harvest crop loss and grain storage structures.

Insects and forest ecosystems. Insect pests of natural and planted forests (Defoliating lepidopterans, saw flies, beetles, flies. Sap suckers- scale insects, aphids and bugs. Galls and gall insects. Insect pests of timber).

References

Beeson, C.F.C. 1941. The Ecology and Control of Forest insects of India and Neighbouring Countries, Vasant Press, Dehradun, India.

Dajoz, R. 2000. Insects and Forests - The Role and Diversity of Insects in the Forest Environment. Translated by G-M de Rougement, Lavoisier, Paris.

Hill, D.S. 1993. Agricultural insect pests of the tropics and their control. Second edition. Special edition for sale in South Asia only. Cambridge University Press, Cambridge.

Neupane. F.P. 2058 BS. Balibiruwaka shatru ra tinko roktham. Shaja Prakashan. (in Nepali).

Paine, T.D. 2006. Invasive Forest Insects, Introduced Forest Trees, and Altered Ecosystems: Ecological Pest Management in Global Forests of a Changing World. Springer.

Richards, O.W. and Davies, R.G. 1977. Imm's general textbook of entomology. 10th edition vol. II Classification and Biology. Chapman and Hall, London.

Speight, M.R. and Wylie, F.R. 2000. Insect Pests in Tropical Forestry. CABI Publishing.

Semester III

Entomology

Course Title: Pest Management

Credits: 4

Course No.: Ent 610

Lecture hrs: 60

Nature of the Course: Theory

Full Marks: 100

Pass Marks: 50

Course Objectives

- To orient the students with classification and mode of action of insecticides, their applications, hazards and safety measures.
- To develop an understanding of Integrated Pest Management (IPM).
- To develop fundamental knowledge on biocontrol agents in pest managements.
- To acquaint students with current regulatory provisions on insecticide application

Course Contents

Toxicology: Historical background of insecticide use. Classification of pesticides (based on mode of entry, based on mode of action, based on toxicity, and based on chemical nature). Mode of action of pesticides. Pesticide Act and Regulations. Insecticide toxicity, formulations and Synergism. Bioassay techniques. Insect resistance to insecticides. Semiochemicals. Insecticide calculation. Pesticide application equipments. Health hazards and safety measures of pesticide application. Pesticides and, environmental consequences. **25 hrs**

Pest Management: Concept of insect pests and their management. Integrated pest management: concept and techniques of IPM (cultural, physical, chemical, mechanical, biological and legislative approaches). Botanical pest management. Insect pest management through resistance of plants. Quarantine entomology in Nepal, Research and regulatory issues in quarantine approach- WTO and Pest Risk Assessment (PRA). Current developments in pest management. Biology of pathogens (bacteria, protozoa, nematodes, fungi, viruses, rickettsiae) and their use in pest management. . Management of plant disease through vector management. **35 hrs**

References

Neupane, F.P. (ed.).2003. Integrated pest management in Nepal: Proceedings of a National Seminar, Kathmandu, Nepal, 25-26 September 2002. Himalayan Resources Institute, New Baneswor, Kathmandu, Nepal. xvi+349 pp.

New T. 1988. Associations between insects and plants. NSW University Press.

Youdeowei, A. and Service, M.W. 1983. Pest and vector management in tropics with particular reference to Insects, Ticks, Mites and Snails. Longman, London.

Hill, D.S. 1993. Agricultural insect pests of the tropics and their control. Second edition. Special edition for sale in South Asia only. Cambridge University Press, Cambridge.

Matthews, G. 1995. Pesticide Application Methods. Wiley Blackwell; 2nd Revised edition, 405 pp.

Walter, G.H. 2008. Insect Pest Management and Ecological Research. Cambridge University. Press. 400 pp.

Neupane, F.P. 2002. Integrated Management of Vegetable Insects. Jagadamba Press, Lalitpur.

Mengech, A.N., Saxena, K.N. and Gopalan, H.N.B. 1995. Integrated pest management in the tropics: Current status and future prospects. UNEP, John Wiley and Sons. Chichester, New York.

Semester III

Entomology

Course Title: Medical & Industrial Entomology & Research Methodology II

Credits: 4

Course No.: Ent 611

Lecture hrs: 60

Nature of the Course: Theory

Full Marks: 100

Pass Marks: 50

Course Objectives

- To provide fundamental knowledge to students regarding major insects of medical, veterinary, and industrial importance.
- To develop practical knowledge on research tools and techniques to study insects and impart scientific writing skills.

Course Contents

Medical Entomology: Introduction to medical and veterinary entomology. Overview of vectors and vector borne diseases in Nepal. Vector ecology. Vector pathogen interaction. Insecticide resistance in vector. Climate change and vector distribution. Morphology, life history, pathology and importance of : mosquitoes, sandflies, houseflies, fleas, eye gnats, cockroaches, black flies, horse flies, ticks and mites, bed bugs and sucking lice. An introduction to forensic entomology, general terms & background history of forensic entomology, insects associated with forensic science. **20 hrs**

Industrial Entomology: Apiculture: Overview of beekeeping in global and Nepalese perspectives. Honeybee species. Different types of bee hives and significance. Apiary management (management of bee colony, forages and crop pollination). Diseases and enemies of honey bees. Quality of honey and global market. **10 hrs**

Sericulture: Overview of sericulture in global and Nepalese perspectives. Mulberry plantation, propagation and nursery establishment. Mulberry pests and their management. Silkworm rearing, cocoon production, care and storage. Pests of silkworms and their management. Non-mulberry silkworms. Silk production and marketing. **Lac culture:** Lac insects and their culture. Prospects and possibilities in Nepal. **10 hrs**

Research Methodology: Tools and techniques of insect collection, preservation and maintenance. Research process (Selection and formulation of the research problem. Literature review. Formulation of research objectives. Development of workable hypothesis. Research design. Sampling and sample size. Data collection, statistical analysis and presentation). Scientific writing: proposal/ report/ thesis/ paper. Ethics of research and publication. **20 hrs**

References

- Chandler, A.C. and Read, C.P.1961. Introduction to Parasitology with special reference to the parasites of man. John Wiley & Sons Inc. New York. 821 pp.
- Cheng, T.C. 1986. General Parasitology Second edition. Academic Press.827 pp.
- Eldridge, B.F. and Edman, J.D. 2003. Medical Entomology: A Textbook on Public Health and Veterinary Problems Caused by Arthropods. Springer; 2nd revised ed.
- Faust, E.C., Russel, P.F. and Jung, R.C. 1970. Craig and Faust's Clinical Parasitology. EA & Febiger, Philadelphia.
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- Verma, L.R. (ed.) 1992. Honeybees in mountain agriculture. Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.
- Verma, L.R. 1990. Beekeeping in integrated mountain development. Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.
- Wall, R. and Shearer, 2001. Veterinary Ectoparasites: Biology, Pathology and Control 2nd Edition. Wiley Blackwell.

Semester III

Entomology

Course Title: Dissertation Proposal & Seminar

Credit: 1

Course No. Ent 614

Lectures: 60

Nature of the course: Research

Full Marks: 25

Pass Marks: 12.5

Objective

To strengthen the knowledge of students in research based academic activities and to develop a research proposal of thesis for semester IV.

The students will select topic for their research work related to their special/elective paper. The students will prepare a research proposal by studying published research works in the related area. The research proposal will be discussed with research committee of the department. After which the department will formally appoint supervisor/s for the research project. Each student will work for research under the supervision of assigned supervisor in the department. After completing the proposal, it is mandatory to present in a seminar.

Semester III

Course Title: General Entomology & Taxonomy

Full Marks: 50

Course No.: Ent 612

Pass Marks: 25

Nature of the Course: Practical

Semester: III

Course Objectives

- To acquaint the students practically with morphology, anatomy, physiology and embryology of insects.
- To provide students with practical knowledge of handling and studying insects.
- To give practical knowledge to the students regarding collection, preservation, and identification variety of insect fauna.

Course Contents

Insect Morphology: Morphology of major insect orders mentioned in Ento 609 focussing modifications in mouthparts, wings and legs.

Internal Anatomy: Dissection of commonly available insects to study their alimentary canal, nervous system, reproductive organs, tracheal system.

Embryology & Development: Types of metamorphosis. Types of larvae, pupae.

Insect Taxonomy:

Collection and preservation of insects: Tools and techniques of insect collection, Collection of insects of different orders from diverse habitat types: Forest, Agricultural lands, Grassland, Lakes, Pond, River and Streams. Insect preservation techniques.

Study of orders of insects and their identification using taxonomic keys. Keying out families of insects of different major Orders: Odonata, Orthoptera, Blattodea, Mantodea, Isoptera, Hemiptera, Thysanoptera, Neuroptera, Coleoptera, Diptera, Lepidoptera and Hymenoptera.

Identification up to species: Students need to identify at least 20 species from their own collection up to species level (students need to prepare camera lucida drawings, photographs, and slides of appropriate organs like antenna, wings, legs, genitalia or whole mount whenever necessary). The numbers and insect groups are given as follows;

Ametabolous - 4

Hemimetabolous - 6

Holometabolous - 10

Specimen Deposition: Students must register their identification and indicate ID number in their practical class record. This ID number remains as permanent deposition of the animal and entomologists and researchers have access to these specimens.

Identification Report: Students need to present their identification report.

Semester III

Course Title: Pest Management, Med. & Ind. Entomology

Full Marks: 50

Course No.: Ent 613

Pass Marks: 25

Nature of the Course: Practical

Semester: III

Course Objectives

- To provide practical knowledge on pests and their natural enemies.
- To give practical knowledge to rear, manage pest species and commercially important fauna.
- To handle equipments used in entomology as well as in the pest management.
- To acquaint the students with techniques to estimate insect population of different habitats and analyse insect fauna of different environmental variables.
- To provide students with practical knowledge of research techniques in insect ecology, medical and public health related insects.

Course Contents

Collection, mounting and identification of important pests and their natural enemies on different crops

Study of life history of important insect pests and non-insect pests.

Mass rearing of insects (parasites, predators, host insects, pathogens) in laboratory.

Assessment of pest status, Yield loss assessment and assessment of crop damage level. Pest damage patterns (defoliator, leaf minor, borers, gall insects etc).

Handling and calibration of sprayers. Pesticide calculations. Handling pesticide application equipments.

Evaluation of commercially available domestic insect pest control products through bioassays.

Indigenous pest control techniques in rural areas of Nepal.

IPM in crop protection practices in Nepal, Field visit to horticultural growers/ agencies and report preparation.

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. Visit to bee nursery and commercial apiaries.

Silkworm rearing and management. Lac processing, products and bye-products of lac.

Collection, mounting and identification of insects of medical and veterinary importance. Vector sampling techniques.

Review of literature in the given topics, preparation of review article, scientific paper writing.

Measurement of biodiversity indices of insects– (a) population, (b) density and relative density, (c) frequency and relative frequency, (f) abundance and distribution, (g) Shannon- Wiener index.

Extraction of soil fauna by using Burlese funnel and comparison with soil properties (moisture, pH, NPK).

Analysis of water quality (DO, CO, temperature, BOD, turbidity).

Semester IV

Entomology

Course Title: Insect Ecology & Behaviour

Credits: 3

Course No.: Ent 653

Lecture hrs: 45

Nature of the Course: Theory

Full Marks: 75

Pass Marks: 37.5

Course Objectives

- To make the students understand concepts of ecology with emphasis on insect systems.
- To acquaint students with insect behaviour.

Course Contents

Insect Ecology: An overview. Insect as ecological indicator. Insect populations and communities: Spatial structure and dynamics of insect populations, life tables, regulation of populations by density-dependent and density independent processes; predator prey systems, evolution of insect feeding modes, insect relationships (competition, parasitism, parasitoids, predation, mutualism), aquatic fauna and river health assessment, high altitude insects, ecological role of insect outbreak, insect monitoring and forecasting, pollination ecology, coevolution and mutual benefit to plants and pollinators, factors affecting pollination. Conventions and social issues in insect diversity. Ecology of urban insect pests. Economic and ecological decision making. Biodiversity assessment methods and need for insect conservation. **15 hrs**

Insect Macroecology: Introduction. Concept of Alpha, Beta and Gamma diversity. Relative role of environmental and spatial processes (environmental niche versus dispersal limitation of insects species) Global patterns of insects richness, Insects in elevational and latitudinal gradients. Determinants of richness - equilibrium processes. Relationships among range size, occupancy and abundance. phylogenetic diversity and species diversity. Determinants of insects species richness - local vs regional processes. Biogeographic processes in insects (vicariance, dispersal, endemism and extinction Body size distribution in insects). Allometry, metabolism and ecological consequences. Species-area relationship. Rarity and spatial variation. Fragmented landscape and metapopulation (with reference to Siwalik hill of Nepal). Climate change and insects diversity. **20 hrs**

Insect behaviour: An overview. Basic responses and patterns of behaviour, behavioural periodicity and clocks, oriental navigation and homing, feeding behaviour, defence behaviour, foraging behaviour, resting behaviour, visual communication, chemical communication, epigamic behaviour, oviposition behaviour, parental care, presocial behaviour, eusocial behaviour, leadership behaviour. **10 hrs**

References

- Atkins, M. D. 1980. Introduction to Insect Behaviour. MacMillan Publishing Co. Inc. New York.
- Blackburn, T.M., Gaston, K.J. 2003. Macroecology : Concepts and Consequences
- Bonner, J. T. 2006. Why Size Matters: From Bacteria to Blue Whales, Princeton, NJ: Princeton University Press, 2006.
- Brown J.H. 1995. Macroecology. University of Chicago Press.
- Dempster, J.P. and McLean, I.F.G. (Eds) 1999. Insect Populations: In Theory and in Practice. Springer.
- Hanski, I. 1999 Metapopulation Ecology. Oxford university press.
- Huxley, J. S. 1924 Constant differential growth-ratios and their significance. *Nature*
- Price, P.W. 1975. Insect ecology. John Wiley and Sons, New York.
- Ricklefs, R.E. 1994. Species Diversity in Ecological Communities. University of Chicago press.
- Samways, M.J. 2005. Insect Diversity Conservation. Cambridge University Press.
- Schowalter, T.D. 2006. Insect Ecology: An Ecosystem Approach. Academic Press; 2nd edition.
- Southwood, T.R.E. and Henderson, P.A. 2000. Ecological Methods. III Edition. Blackwell Science.
- Speight, M.R., Hunter, M. D. and Watt, A.D. 2008. Ecology of Insects: Concepts and Applications. WileyBlackwell; II Edition.

Semester IV

Entomology

Course Title: Thesis

Credits: 4

Course No.: Ent 654

Full Marks: 100

Nature of Course: Research (Compulsory)

Pass Marks: 50

General Objective

To produce M.Sc. dissertation based on original research study in priority areas of Entomology.

Specific Objective

- To develop scientific observation of natural phenomenon, skill to analyze and understand for logical interpretation.
- To know various methodological tools including instruments and apply them in the field studies.
- To develop confidence on seminar presentation and defend the dissertation work.

Dissertation Work

The dissertation work is compulsory for all students in order to develop skills and handle the research study independently. The students work on the proposal developed in Zoo 614 of semester III under the formally appointed dissertation supervisor/s. However, the student is able to work independently and has to take full responsibility in completing the proposed task on time. The supervisor should be available for consultation and review. The dissertation is evaluated by a committee of experts including an external examiner. Students have to present their work and defend it in a public defence.

The Student must complete a dissertation work and should submit it within the academic session of the fourth semester. The duration can however be extended by the research committee with the consent of the head of the department on student's request form and recommendation of the concerned supervisor with reasonable explanation.

References

- Atkins, M. D. 1980. Introduction to Insect Behaviour. MacMillan Publishing Co. Inc. New York.
- Beeson, C.F.C. 1941. The Ecology and Control of Forest insects of India and Neighbouring Countries, Vasant Press, Dehradun, India..
- Blackburn, T.M., Gaston, K.J. 2003. Macroecology : Concepts and Consequences
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