



Bangladesh Open University



School of Agriculture and Rural Development (SARD)

Master of Science (MS) in Entomology

Curriculum layout for the degree of Master of Science (MS) in Entomology

1. Requirement for registration: Bachelor of Science in Agriculture (BSc Ag) or related disciplines from any recognized University or Institute
2. Duration: One and a half ($1\frac{1}{2}$) years (Registration valid for consecutive four and a half years)
3. Semester: Three Semesters (Valid up to consecutive nine semesters), two semesters in a year each of six (6) months
4. No. of courses = 12
5. No. of credits = 40
6. Total Marks = 2000

Distribution of courses, credits and marks

M.S. in Entomology shall be offered with 40 credits in 3 semesters each of six months duration. The courses worth 24 credits of which 12 credits shall be offered during the first semester and the other 12 credits during the 2nd semester respectively for the students. Another 16 credits shall be reserved for the research (thesis and thesis defense). The students have to start their research work for thesis (equivalent to 6 courses) under the guidance and supervision of his/her Research Supervisors after the completion of one semester and the same shall be carried through to the last semester when it will be evaluated. After the evaluation of thesis the students have to face thesis defense (equivalent to 2 courses). The distribution of courses, credits and marks are shown below:

Course Type		No. of Courses	Credits	Marks
Course (compulsory)		12	24	1200
Research	a) Thesis	equivalent to 6 courses	12	600
	b) Thesis defense	equivalent to 2 courses	4	200
Total			40	2000

N.B. 1 course = 2 credits = 100 marks; Thesis = 12 credits = 600 marks, Thesis defense (4 credits) = 200 marks: Each course will carry 80 marks for theoretical examination and 10 marks for one course assignment and 10 marks for class attendance.


Course layout for MS in Entomology

1st Semester

Sl.	Courses Title	Course code	Credit hrs.	Marks
1	Insect Ecology	MSENT 1201	2	100
2	Insect Morphology	MSENT 1202	2	100
3	Insect Physiology	MSENT 1203	2	100
4	Insect Taxonomy	MSENT 1204	2	100
5	Industrial Entomology	MSENT 1205	2	100
6	Insect Pathology	MSENT 1206	2	100
Total 6 courses			12	600



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2nd Semester

Sl.	Courses Title	Course code	Credit hrs.	Marks
1	Principles of Acarology	MSENT 2201	2	100
2	Integrated Pest Management	MSENT 2202	2	100
3	Insecticide Toxicology	MSENT 2203	2	100
4	Stored Product Entomology	MSENT 2204	2	100
5	Biological Control	MSENT 2205	2	100
6	Entomological Technique	MSENT 2206	2	100
Total 6 courses			12	600

3rd Semester

Title	Credit	Mark
a. Thesis (equivalent to 6 courses)	12	600
b. Thesis defense (equivalent to 2 courses)	4	200
Thesis + Thesis defense	16	800
Grand Total	(12×2)+16 = 40 (Forty)	2000

Syllabus for MS in Entomology

Course Title: Insect Ecology

Credit hours: 2

Course Code: MSENT 1201

Unit	Title	Lesson
1	Population Ecology	Ecosystem and components of environment, Influence of physical (temperature, moisture and light) and biotic factors of environment on insect populations, variation in intensity of diapause and voltinism, population growth, Insect polymorphism, life table, population dynamics-conceptual aspects and modeling
2	Trophic Relationships	Primary and secondary metabolic products, host selection by insects, monophagy and polyphagy, predation models, numerical and functional responses, insect and host plant relationship, adaptive radiation and equilibrium in populations, insect- insect and microorganism mutualism
3	Communities and Diversity	Concept of communities and diversity, component communities, succession and diversity index, climatic stability
4	Dispersal and Migration	Dispersal and migration of insect population, factors of dispersal, dispersal of aphids and thrips and migration of locusts
5	Experimental Ecology	Types of insect distribution, methods of measuring distribution patterns, absolute methods of insect population estimation, relative methods of insect population estimation, monitoring of insects

Recommended Textbooks


- Price, P.W. 1984. Insect Ecology. John Willey and Sons, New York, Toronto. Singapore.

Supplementary Textbooks

- Andrewartha, H.G. and L.C. Birch. 1970. The Distribution and Abundance of Animals. The Univ. Chicago Press, Chicago and London.
- Gilott, C. 1982. Entomology. Plenum Press, New York and London.
- Huffaker, C.B. and A.P. Gutierrez. 1999. Ecological Entomology. John Willey & Sons, Inc. New York.
- Odum, E.P. 1971. Ecology. Holt Rinehart & Winston, London, New York.



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6. Schowalter, T.D. Insect Ecology. Academic Press, New York, London, Tokyo.
7. Speight, M.R., M.D. Hunter and A.D. Watt. Ecology of Insects : Concepts and Applications. Blackwell Science, Oxford.

Course Title: Insect Morphology

Credit hours: 2

Course Code: MSENT 1202

Unit	Title	Lesson
1	General body form, Segmentation and Integument	Introduction to general body form and segmentation, the Integument and body wall processes
2	The Head and its Appendages	General structure of head, head skeleton and tentorium, modification in head capsule and head orientation, the antennae and their functions, mouth parts-mandibles, maxilla, labium, labrum, hypopharynx and epipharynx, the chewing, rasping sucking, piercing sucking and chewing lapping type mouthparts, the sponging, cutting sponging, siphoning and degenerative type mouthparts
3	The Thorax	Legs and their modification, wings and their modification
4	The Abdomen	Abdominal segments, abdominal appendages
5	Digestive System	Organs of alimentary canal and salivary glands, structure of stomodeum, mesenteron and proctodeum
6	Respiratory System	Organs of respiration, classification of respiration, terrestrial respiratory organs, aquatic respiratory organs
7	Circulatory System	Components: haemolymph, haemocoel, dorsal vessel, accessory pulsatile organs, phagocytic organs, haemolymphs, types of haemocytes, functions of haemolymph and haemocytes
8	Excretory System	Excretory organs, the accessory organs for excretion
9	Nervous System	Neurons, its types and functions, types of nervous system
10	The Sense Organs	Mechanoreceptor : tactile organs, campaniform organ, chordotonal organ, static organ and Johnston's organ, chemoreceptor : common, gustatory, olfactory chemoreceptor and their morphological classification
11	Reproductive System	Organs of male reproductive system, organs of female reproductive system, male and female genitalia, types of special modes of reproduction with examples

Recommended Textbooks


1. Snodgrass, R.E. 1935. Principles of Insect Morphology. McGraw Hill Book Co., New York.

Supplementary Textbooks

2. Borror, D.J., M.D. DeLong and C.A. Triplehorn. 1976. An Introduction to the Study of Insects. Holt. Rinehart and Winston, New York.
3. Downer, R.G.H. 1987. Energy Metabolism in Insects. Plenum Publ. Corp., New York.
4. Essig, E.O. 1942. College Entomology. Macmillan Co., New York.
5. Imms, A.D. 1957. A General Textbook of Entomology. Methuen and Co., London.
6. Ross, H.H. 1965. A Textbook of Entomology. John Wiley, New York.
7. Snodgrass, R.E. 1954. Insect Metamorphosis. Smithsonian miscellaneous collections. Vol. 122, No. 9, Smithsonian Institution. Washington, D.C., U.S.



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Course Title: Insect Physiology

Credit hours: 2

Course Code: MSENT 1203

Unit	Title	Lesson
1	Insect Nutrition	Importance and principles of insect nutrition, general requirements of insect nutrition, artificial diet
2	Digestion and Absorption of Food	Functions of foregut, midgut, hindgut and salivary glands, process of digestion and absorption of food
3	Metabolism of Nutrients	Metabolism of carbohydrates, proteins and lipids
4	Circulation of Blood	Mechanism of blood circulation-main body and appendages
5	Respiration	Respiration in terrestrial, aquatic and endoparasitic insects
6	Nervous System and Neurophysiology	Physiology of nervous system, insect hormones, pheromones and their types, functions of insect hormones and their mode of action, functions of pheromones and their mode of action
7	Muscular Physiology and Locomotion	Structure and physiological properties of insect muscles, mechanism of locomotion
8	Reproduction	Oogenesis and spermatogenesis, mating, impregnation and fertilization, factors controlling fertility and fecundity
9	Excretion	Physiology of excretion, excretory products and storage of excretion, salts and water balance
10	Growth and Development	The growth laws, moulting, metamorphosis, development of embryo, determination of characters during post-embryonic development, regeneration and diapause

Recommended Textbooks

1. Wigglesworth, V.B. 1967. The Principles of Insect Physiology. Mathuen and Co., London.

Supplementary Textbooks

2. Borkevee, A.B. and T.J. Kelly, 1984. Insect Neurochemistry and Neurophysiology. Plenum Press, No. 1. London.
3. Bhaskarau, G., S. Friedman and J.G. Rodriguez. 1981. Current Topics of Insect Endocrinology and Nutrition. Plenum Publ. Co., New York.
4. Borrer, D.J., M.D. DeLong and C.A. Triplehorn. 1976. An Introduction to the Study of Insects. Holt, Rinehart and Winston, New York.
5. Gillmour, D. 1966. The Metabolism of Insects. Oliver and Boyd., London.
6. Imms, A.D. 1957. A General Textbook of Entomology. Mathuen and Co., London.
7. Nordland, D.A. 1981. Semiochemicals. Wiley, New York.
8. Novak, V.J.A. 1966. Insects Hormones. Mathuen and Co., London.
9. Patton, H.R. 1963. Introductory Insect Physiology. Saunders, Phila.
10. Richards, O.W. and R.G. Davis. 1977. Imms General Textbook of Entomology. Vols. I & II. Chapman and Hall, London.
11. Rodder, K.D. 1963. Insect Physiology. John Wiley, New York.
12. Ross, H.H. 1965. A Textbook of Entomology, John Wiley, New York.
13. Shorey, H.H. and J.J. Mekelvey, Jr. 1977. Chemical Control of Insect Behaviour : Theory and Application. John Wiley & Sons, London & New York.

Course Title: Insect Taxonomy


Credit hours: 2

Course Code: MSENT 1204

Unit	Title	Lesson
1	International Rules of Zoological Nomenclature	Historical and philosophical basis of nomenclature, origin of the binomial system, international codes of nomenclature and international commission, nomenclature type, method and its significance, formation of generic names. specific trivial names and intraspecific names
2	Taxonomic Categories and	Different taxonomic categories, species concepts and their application, theories of



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	Species Concept	biological classification
3	Taxonomic Characters, Collections and Identifications	Taxonomic characters, collections and identifications
4	Taxonomic Study of Insects	Classification and phylogeny of insects, study of some orders, genera and species of economic importance, methods of insect collection and preservation, study of adults and immature forms of economic groups, types of insect larvae and pupae and their identification
5	Chaetotaxonomy, Chemotaxonomy and Numerical Taxonomy	Chaeto and chemo taxonomy, numerical taxonomy
6	Presentation of Taxonomic Findings	Descriptions of taxonomic findings, keys and phylogenies of taxonomic findings
7	Taxonomic Publications and Literatures	Synopsis and reviews, revisions, monographs, atlases, faunal works, field guides and manuals, handbooks, catalogues and checklists, descriptions of new taxa, evolutionary and biological publications

Recommended Textbooks

1. Borror, D.J., D.M. DeLong and C.A. Triplehorn. 1976. An Introduction to the Study of Insects. Holt, Rinehart and Winston, New York.

Supplementary Textbooks

2. Bisby, F.A., J.G. Vaughan and C.A. Wright. 1980. Chaemosystematics, Principles and Practices. Academic Press, New York.
3. Chamberlin, W.J. 1952. Entomological Nomenclature and Literature. Wm. C. Brown, Dubuque, Iowa.
4. Goto, H.E. 1982. Animal Taxonomy, Edward Arnold, London.
5. Lincoln, R.J., G.A. Boxshall and P.F. Clark. 1981. A Dictionary of Ecology, Evaluation and Systematics. Cambridge Univ. Press, Cambridge.
6. Alam, M.Z. 1967. A Report on the Survey of Insect and Mite Fauna of East Pakistan. Agril. Res. Inst. Publ., Dhaka.
7. Ball, G.E. (Ed.). 1985. Taxonomy, Phylogeny and Zoogeography of Beetles and Ants. Dr. W. Junk Publishers, The Hague.
8. Gapud, V.P. 1992. Insect and Mite Pests of Plant Crops in Bangladesh and Their Natural Enemies, USAID/BARC/Checchi & Co. Publ.
9. Mani, M.S., 1982. General Entomology. Oxford & IBH Publ. Co., New Delhi.
10. McNutt, D.N. 1976. Insect Collecting in the Tropics. Centre for Overseas Pest Research, London.
11. Pruthi, H.S. 1969. A Textbook of Agricultural Entomology, Indian Council of Agricultural Research New Delhi.
12. Richards, O.W. and Davies, R.G. 1977. Imm's General Textbook of Entomology. Vol. 2. Classification and Biology, Chapman and Hall, London.

Course Title: Industrial Entomology


Credit hours: 2

Course Code: MSENT 1205

Unit	Title	Lesson
1	Introduction	Industrial insects and industrial entomology
2	Sericulture	Economic importance of silkworm and their host plants, biology of silkworm, silkworm rearing-environmental requirements, equipments space/houses and egg production, brushing, feeding and leaf quality, bed cleaning and care at moulting, methods of rearing (early and late stage larvae), moulting, cocoon harvesting and reeling, diseases of silkworm- protozoan and bacterial diseases, diseases of silkworm-fungal and viral diseases, enemies of silkworm-larval pests (uzi fly, ant, mite and other pests) and cocoon pests, technique of race development, moriculture-varieties and cultivation of mulberry plants, management of mulberry garden
3	Apiculture	Economic importance of honey bee, species, caste and life cycle of honey bee, bee box, catching and hiving of bee swarm, colony management, bee diseases- bacterial, protozoan, fungal and viral diseases, bee enemies-parasites, predators and mites, honey collection- extraction, refining and



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preservation, wax collection

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| 4 | Lac-culture | Prospect of lac culture in bangladesh, species, strains, host plants and life history of lac insect, rearing technique of lac insect, manufacture of shellac and its uses, enemies of lac insect |
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Recommended Textbooks

1. Pruthi, H.S. 1969. A Textbook of Agricultural Entomology. Indian Council of Agricultural Research, New delhi.

Supplementary Textbooks

2. Cooper, E.K. 1964. Silkwoms and Science. Butterworth Press, London. 128 pp.
3. Mace, H. 1976. The Complete Handbook of Beekeeping. Ward Lock Limited. London. 192 pp.
4. Morie, Y. and M. Watanable. 1980. Recent Advances in Sericulture. Ann. Rev. Entomol. 25 : 49-71.
5. Islam, B.N. 1981. Improvement of Silkwom Multiplication and Silk Production under Bangladesh condition. Dept. of Entomology, BAU, Mymensingh. 83. pp.
6. Krishnaswami, S. *et al.* 1978. Sericulture Manual 2. Silkwom Rearing. Central Sericulture Research and Training Institute, Mysore, India. 131 pp.
7. Rahman, S.M. 1984. Studies on the Genetic Improvement of Eri-Silkwom. *Philosamia ricini* Boisd of Bangladesh. A PhD Thesis, Dept. of Zoology, Rajshahi University, Rajshahi. 419 pp.
8. Sarkar, D.C. 1980. Sericulture in India. Central Silk Board, Bombay, India. 51pp.
9. Singh, S. 1982. Beekeeping in India. Indian Council of Agricultural Research, New Delhi. 214 pp.

Course Title: Insect Pathology

Credit hours: 2

Course Code: MSENT 1206

Unit	Title	Lesson
1	Introduction	Insect pathology and its importance in Bangladesh
2	Insect Diseases	Definition and types of insect diseases, etiology-amicrobial and microbial diseases, diagnosis of diseases of natural enemies and their management
3	Physiopathology	Portals of entry and mode of infection- bacteria & delta-endotoxin, viruses, microsporidia and fungi, nematodes and rickettsiae, physiopathology of insect- alimentation and respiration, circulation and adipose tissues
4	Immunity in Insect	Definition and types of insect immunity, factors attributing immunity in insect, mechanism of insect resistance to pathogens
5	Microbial Pesticides	Microbial pesticides, methods of isolation, purification and counting- microsporidia, fungi, viruses, nematodes and bacteria, mass production technology- bacteria, virus (NPV) and fungi
6	Microbial Control	Integration of microbial pathogens- protozoa, nematodes and rickettsia, factors affecting efficacy of microbial pathogens, approaches, advantages and disadvantages of microbial control, application technology, potential microbial pathogens of Bangladesh
7	Epizootiology	Concept and modeling of epizootiology, factors influencing on insect epizootiology- pathogen population, host population, transmission of pathogen and environment
8	Genetically Engineered Pathogen	Concept and present status of genetically engineered pathogens, application of genetically engineered pathogens in pest management

Recommended Textbooks


1. Steinhaus, E.A. 1963. Insect Pathology. An Advanced Treatise. Vols. 1 & 2. Academic Press, New York, London.

Supplementary Textbooks

2. Bulla, L.A. Jr. and T.C. Cheng. 1977. Comparative Pathology. Vols. 1, 2 and 3, Plenum Press, New York and London.
3. Cantweel, G.E. 1974. Insect Diseases. Vols. 1 and 2. Marcel.
4. Debach, P. 1964. Biological Control of Insect Pests and Weeds. Chapman and Hall, London.



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- Fuxa, J.R. and Y. Tanada. 1987. Epizootiology of Insect Diseases. John Wiley and Sons, New York, Chichester, Brisbane, Toronto, Singapore.
- Metcalf, R.L. and W.H. Luckmann. 1975. Introduction to Insect Pest Management. John Wiley and Sons. New York, London, Sydney, Toronto.
- Smith, K.M. 1967. Insect Virology, Academic Press, New York and London.

Course Title: Principles of Acarology

Credit hours : 2

Course Code: MSENT 2201

Unit	Title	Lesson
1	Concept of Acarology	Introduction to acarology, different stages of acari
2	Classification of the Acari	Introduction , order norostigmata, holothyrida, ixodida, mesostigmata, prostigmata, astigmata and oribatida
3	Integument and Moulting	Integument, moulting
4	Segmentation, Musculature and Legs	Segmentation, musculature, legs
5	Mouthparts, Feeding and Adaptations of the Mouthparts	Mouthparts, feeding, adaptations of the mouthparts
6	Respiratory, Circulatory, Nervous System and Sense Organs	Respiratory system, circulatory system, nervous system, sense organs
7	Excretion, Reproduction, Development and Dispersal	Excretion, reproductive system - male and female, mating behaviour, methods. of sperm transfer and oviposition, development and dispersal

Recommended Textbooks

- Evans, G.O. 1992. Principles of Acarology. CAB International, Wallingford, UK.563pp. (Web : <http://www.cabi.org>)

Supplementary Textbooks

- Akimov, I.A. 1985. Biological Foundations of Harmfulness in Acaroid Mites. Naukova Dumka, Kiev., 160pp.
- Anderson, D.T. 1973. Embryology and Phylogeny in Annelids and Arthropods, International Series of Monographs on Pure and Applied Biology : Zoology Division, Vol. 50. Pergamon Press, Oxford, 495pp.
- Baker, E.W. and G.W. Wharton. 1952. An Introduction to Acarology. Macmillan, New York, 465pp.
- Evans, G.O., J.G. Sheals and D. Macfarlane. 1961. The Terrestrial Acari of the British Isles . Vol. 1. British Museum, London, 219pp.
- Fain, A., B. Guerin and B.J. Hart. 1988. Acariens Allergies. Allerbio, Belgium, 179pp.
- Gilyarov, M.S. (ed.) 1978. Handbook for the Identification of Soil-Inhabiting Mites, *Trombidiformes*. Zoological Institute of the Academy of Science, SSSR, Leningrad, 717pp.
- Jeppson, L.R., H.H. Keifer and E.W. Baker. 1975. Mites Injurious to Economic Plants. University of California Press, Berkeley.
- Krantz, G.W. 1978. A Manual of Acarology, 2nd edn. Oregon State University Book Stores, Corvallis.
- Treat, A.E. 1975. Mites of Moths and Butterflies. Comstock Publishing Associates, Ithaca & London.
- Van der Hammen, L. 1989. An Introduction to Comparative Arachnology. SPB Academic Publishing, The Hague, 576pp.

Course Title: Integrated Pest Management


Credit hours : 2

Course Code: MSENT 2202

Unit	Title	Lesson
1	Introduction to Integrated Pest Management	Origin of the term IPM, definitions of IPM, philosophy of IPM, ecological approaches in the pest control. the origins of pests, ecological causes of pest problems, genesis of pest control, major events in the history of pest control. basic principles of IPM and guidelines for IPM programs
2	Ecological Concepts of Pest Management	Definition of ecosystem, components of ecosystem, biotic interactions in



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		ecosystem, energy flow, colonization of island vis-a-vis theory of island biogeography, ecological/community succession, evolution of population and species, some ecological principles for application
3	The Economics of Pest Management	The economic threshold concept, economic research on IPM, economics of insect control in the farm/the private economics of pest management, impact of govt. activities on use of insect control systems, conflicts of interest in ecosystem management, the social implications of pest management decisions, environmental quality, hazard to health
4	The Quantitative Basis of Pest Management: Sampling and Measures	Absolute methods and relative methods, insect products, assessing plant damage and crop yield loss, dispersion and the sampling program
5	Analysis and Modeling in Pest Management	Analysis of natural and agro ecosystem, classes of descriptive models, life tables, building and using static models, the operating of pest management systems, designing/recommendation algorithm, using models to build and algorithm, IPM tactics/tools, decision-making in IPM, decision tree, use of computers in IPM, types of IPM models, tactical model, typical on-line pest management system.
6	Cultural Practices in Pest Management	Destruction of residues, alternative hosts and volunteer plants, dates of sowing and harvesting chosen to avoid pest attack, good husbandry, rotation of crops to avoid building up of pests, cropping systems, plant density, other practices
7	Host Plant Resistance in Pest Management	Definition, historical development, insect-plant interactions, host plant selection and mechanisms of resistance, genetic basis of resistance, effect of environmental factors on the expression of resistance, implementation of programs in crop resistance, plant resistance in pest management
8	Parasitoids and Predators in Pest Management	Definitions and concepts, natural control and biological control, feasibility of biological control, management considerations, evaluation, conclusion
9	Insecticides in IPM	Advantages of insecticides for pest management, limitations in the use of insecticides for pest management, proper use of insecticides in pest management, selecting insecticides for pest management programs, model pest management programs using insecticides, conclusion
10	Use of Insect Pathogens in Pest Management	Characteristics of insect diseases, types of insect pathogens, insect diseases as naturally occurring mortality factors. Introduction and application of insect diseases for long term suppression, microbial insecticides, role of microbial control in pest management programs in future
11	Integrated Pest Management in Developing Countries including Bangladesh	IPM current status with examples, IPM constraints, prospects and future needs, the future strategy for IPM
12	Role of Extension Entomology in IPM	IPM and extension entomology, the forces that influenced extension entomology, future of extension entomology, from integrated control to integrated farming, intelligent crop management (ICM), evaluating the IPM implementation process

Recommended Textbooks

1. Apple, J.L. & R.F. Smith (Eds). 1976. Integrated Pest Management. New York: Plenum Press.

Supplementary Textbooks

2. Atwal, A.S. 1976. Agricultural Pests of Indian and Southeast Asia. Kalyani publishers, New Delhi.
3. Bal, A. & J.C. Van Lenteren. 1987. Integrated Pest Management in the Netherlands: practice, policy and opportunities for the future. Med. Fac. Landbouww. Rijksuniv. Gent, 52: 385-93.
4. Boller, E.F. 1987. Genetic Control. In: Integrated Pest Management, ed. A.J. Bum. T.H. Coaker & P.C. Jepson, pp. 162-87. London: Academic press.



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- Bottrell, D.G. 1799. Integrated Pest Management. President's Council for Environmental Quality. Washington, DC: US Government Printing Office.
- Burgs, H.D. 1981. Microbial Control of Pest and Diseases, 1970-1980. Academic Press, New York.
- Burn, A.J., T.H. Coaker & P.C. Jepson (Eds). 1987. Integrated Pest Management. London: Academic Press.
- Coaker, T.H. 1987. Cultural Methods: The Crop. In: Integrated Pest Management, ed. A.J. Burn, T.H. Coaker & P.C. Jepson, pp. 69-88. London: Academic Press.
- Dent, D. 1991. Insect Pest Management. C.R. International.
- Evans. J.W. 1987. Insect Pest and Their Control, Soni Reprints Agency, Delhi.
- Flint, M.L. & R. van den Bosch. 1981. Introduction to Integrated Pest Management. New York: Plenum Press.
- Matcalf, R.L. & W.H. Luckmann (Eds). 1982. Introduction to Insect Pest Management, 2nd edn. New York: John Wiley & Sons.
- Ramulu, U.S. 1985. Methods of Pesticides Analysis. Oxford and IBH Publ. Co., New Delhi, Bombay and Calcutta.
- Shapa, V.A. 1986. Biological Plant Protection. Publ. Oxonian Prep. Pvt. Ltd, New York.
- Van Eenden, H.F. 1989. Pest Control, Edward Arnold, London.
- Zelazny, B., L. Chiarappa & P. Kemore. 1985. Integrated Pest Control in Developing Countries. FAO Plant Prot. Bull 33: 147-58.

Course Title: Insecticide Toxicology

Credit hours: 2

Course Code: MSENT 2203

Unit	Title	Lesson
1	Introduction to Insecticide Toxicology	Insecticide toxicology, history and general groupings of insecticidal compounds, pesticides- classification and mode of action
2	Metabolism of Insecticides	General types of metabolic activities, oxidation, reduction and hydrolytic processes, glutathione- mediated metabolism, metabolism of organochlorine and organophosphorus insecticides, metabolism of carbonates and pyrethroids
3	Toxicological Studies in Insects	Penetration of insecticides into insects, factors influencing penetration rate, general principles of insecticide resistance, metabolism detoxication as resistance, mixed function oxidation, metabolism by esters and glutathione, genetic aspects of resistance, operational factors influencing resistance, management of resistance
4	Movement of Insecticides in Environment	General aspects, terrestrial plants including agricultural crops, movement in soil, water and air, degradation by sunlight and other physical factors
5	Insecticides Analysis	Principles of insecticide analysis, chromatographic analysis of insecticide residues, spectroscopic methods, analysis of physical properties of formulations, analysis of active ingredient content of insecticides
6	Insecticides and Environmental Health	Food contamination, hazards to man and domestic animals, acute poisoning by insecticidal chemicals, pathological and histological changes on chronic poison, human intake of insecticides through food, toxic effects on insects and wildlife, safety assessment

Recommended Textbooks


- Matsumura, F. Toxicology of Insecticides(2nd edition). 1985. Plenum Press. New York and London.

Supplementary Textbooks

- Agrwal, R.A., Gupta, G.P. Kishore prem and Chandra Dinesh. 1983. Principles and Concepts of Integrated Pest Management. ICAR, New Delhi-110012, India.
- Evans, J.W. 1987. Insect Pest and Their Control. Soni reprints Agency, Delhi.
- Metcalr. E.R. 1981. Management of Insect Pests with Semiochemicals : Concept and Practices. Academic press, new York.
- O'Brien, R.D. 1967. Insecticides, Action and Metabolism. Academic Press, Inc. New York-London.
- Otto, D. and Weber, B. 1992. Insecticides : Mechanism of Action and Resistance. Intercept Andover.
- Ramulu, U.S. 1985. Methods of Pesticides Analysis. Oxford and IBH Publ. Co., New Delhi, Bombay and Calcutta.
- White-Stevens, R. Pesticides in the Environment. Vol. I Part II, Marcel Dekker, Inc., New York and Basel, 629P.



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	Master of Science (MS) in Entomology

Course Title: Stored Product Entomology

Credit hours: 2

Course Code: MSENT 2204

Unit	Title	Lesson
1	Stored Products and Conservation	Types of stored products with characteristics, pest problems of consumers and suppliers, ecology of stored grain pests- temperature and moisture, ecology of stored grain pests-food and population density, assessment of grain moisture content by drying and aeration method
2	Pests of Stored Products	List of different groups of stored product pests with identifying characters, coleopteran insects- beetle and weevil pests, lepidopteran insects- moth pests, rats and mites in storage, types of damage-direct damage, selective eating, contamination and webbing by moth larvae, loss assessment by produce monitoring, physical parameters and sampling, loss assessment by trapping, detection of insect infestation in stored products
3	Storage Facilities Against Pest Attack	General considerations for grain storage, indoor and outdoor storage, modern grain storage, design for conventional installation of storage, installation for buffer reserves, merits and demerits of conventional godown
4	Insect Control	Various physical methods of control of stored grains, preventive and curative measures, moisture content of grains, general considerations of insecticides, insecticides mixed with grains, common fumigants and their composition, principles of fumigation, safety against fumigants and fumigation, insecticides residues and health hazards, use of botanicals, radiation control

Recommended Textbooks

1. Alam, M.Z. 1971. Pests of Stored Grain and Other Stored Products and Their Control. Agric. Inf. Serv., Dhaka.

Supplementary Textbooks

2. Brown, A.W.A. 1961. Insect Control by Chemicals. John Wiley, New York.
3. Cornwell, P.B. 1966. The Entomology of Radiation Disinfestation of Grains. Macmillan Co., New York.
4. Cotton, R.T. 1963. Pests of Stored Grain and Their Products. Burgess Publ. Co. Minn., USA.
5. Hill, D.S. 1990. Pests of Stored Products and Their Control. Belhaven Press, London.
6. Munro, J.W. 1966. Insect of Stored Products.
7. Pingale, S.V. 1978. Handling and Storage of Food Grains. Indian Council of Agricultural Research. New Delhi, India.

Course Title: Biological control


Credit hours: 2

Course Code: MSENT 2205

Unit	Title	Lesson
1	Introduction, Fostering pests	Introduction, definition, history of biological control, fostering pests through misuse of chemicals, some examples of local and foreign countries, insecticide-the ecological narotics, why great insecticide boom, the pesticide syndrome-diagnosis and suggested prophylaxis
2	Pest and Their Natural Enemies (NE) Parasitoid & Predator	Pest and their natural enemies, parasitoid: hymenoptera, dipteran, predatory insects: coleoptera, neuroptera, hymenoptera, diptera, hemiptera and odonata
3	Pest and Their Natural Enemies (microorganism, NE of weed)	Pathogenic microorganism, natural enemies of weeds



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	Master of Science (MS) in Entomology	

4	Biological Control Ecology	Natural control, biological control and population phenomenon, the extent of natural biological control, ecological basis of classical biological control.
5	Measurement and Adaptability of NE	Measurement of natural enemy population, adaptability of introduced/local biological control agents
6	Foreign Exploration and Importation of NE	Introduction, planning and preparation, inventory search and investigation of selected species, importation of NE. example of first foreign explorer, cottony-cushion scale of California (1888-1890), example of modern foreign exploration and success: klamath weed, oriental fruit fly
7	Improvement of NE fitness	Variability in NE fitness, desirable characteristics of NE, improving adaptability of imported species
8	Conservation of NE	Conservation and diversification, methods of conservation
9	Augmentation of NE	Augmentation of NE through mass culture and periodic release in Bangladesh, augmentation of <i>Trichogramma</i> in sugarcane field against sugarcane borers, management of pest population by manipulating densities of both hosts and NE
10	Evaluation of Impact of NE	Introduction, selection of study area and duration of study, population sampling, experimental or comparison method of evaluation, the addition methods, the exclusion method, interference method
11	Microbial Control	Microbial control as a tool in IPM program, virus, fungi, nematode and other pathogenic microorganism
12	Biological Control of Weed	Introduction and some examples of biological control of weed of foreign countries

Recommended Textbooks

1. DeBach, P. (Ed.). 1964a. Biological Control of Insect Pests and Weeds. New York: Reinhold Publishing Corp.

Supplementary Textbooks

2. Askew, R.R. 1971. Parasitic Insects. London : Heinemann Educational Books.
3. Birch, M.C. and K.F. Haynes. 1982. Insect Pheromones. Studies in Biology No.147.London : Edward Arnold.
4. Clausen, C.P.(Ed.). 1978. Introduced Parasites and Predators of Arthropod Pests and Weeds ; a World Review Agric. Handbook 480. Washington, DC ;US Department of Agriculture.
5. Croft, B.A. 1990. Arthropod Biological Control Agents and Pesticides. Somerset : John Wiley & Sons.
6. Deacon, J.W. 1983. Microbial Control of Plant Pests and Diseases. Aspects of Microbiology 7. Washington, DC : American Society of Microbiology.
7. DeBach, P. & K.S. Hagen. 1964. Manipulation of Entomophagous Species. In: Biological Control of Insect Pests and Weeds, ed. P. DeBach, pp. 429-58. New York: Reinhold.
8. Helle, W.& M. W. Sabelis (Eds). 1985. Spider Mites, Their Biology, Natural Enemies and Control. World Crop Pests, Vol. 1B. Amsterdam: Elsevier Science Publisher.
9. Huffaker, C.B. (Ed.). 1971b. Biological Control. New York: Plenum Press.
10. Papavizas, G. C. (Ed.). 1981. Biological Control in Crop Production, Beltsville Symposia in Agricultural Research 5, Totowa: Allanheld, Osmun.
11. Ridgway, R.L. & S.B. Vinson (Eds). 1977a. Biological Control by Augmentation of Natural Enemies. New York: Plenum Press.
12. Samways, M.J. 1981. Biological Control of Pests and Weeds. Studies in Biology No. 132. London: Edward Arnold.
13. Wood, K.R.S. & M.J. Way (Eds). 1988. Biological Control of Pests, Pathogens and Weeds. London: The Royal Society. (Phil. Trans. Roy. Soc. Lond. B 318: 109-376).



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	Master of Science (MS) in Entomology

Course Title: Entomological Technique

Credit hours: 2

Course Code: MSENT 2206

Unit	Title	Lesson
1	Basic Procedures of Microtomy	Procedure for processing tissue, preparation of the fixatives, stains and staining, preparation of insect muscles, nerves and tracheae
2	Concept and Technique of Electron Microscopy	Introduction to electron microscopy, preparative procedures of electron microscopy, staining and examination of slides in electron microscopy
3	Tissue Culture Technique	Introduction to tissue culture, preparation of tissue extracts and tissues, methods for tissue culturing and histological techniques, photomicrography of tissue cultures and use of camera lucida
4	Bioassay of Pesticides	Probit analysis, estimation of LD ₅₀ and LD ₉₀ values of an insecticide.
	Measurement of Population Density and Distribution Patterns	Sampling techniques-random and sequential samplings, binomial distribution and index of dispersion
	Methods of Tagging Insects with Radioisotopes (Demonstrations)	Handling techniques of radioisotopes and marking methods, labels with p ³² incorporated in insect tissues and its detection by autoradiograph

Recommended Textbooks

1. Ham, A.W. and D.H. Cornack. 1979. Histology. J.B. Lippincott., Phila. (8th ed.).

Supplementary Textbooks

2. Andrewrtha, H.G. 1961. Introduction to the Study of Animal Populations. Methuen & Co., Ltd., London.
3. Finney, D.J. 1964. Probit Analysis. Cambridge Univ. Press, Great Britain.
4. Grimstone, A.V. 1976. The Electron Microscope in Biology. Edward Arnold, London.
5. Leeson, C.R. 1976. Histology, Saunders, Phila.
6. Pease, D.C. 1964. Histological Techniques for Electron Microscopy, Academic Press, New York (2nd ed.).
7. Ramulu, U.S.S. 1979. Electron Microscopy of Cells and Tissues. Academic Press, new York.

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