



Shri Vaishnav Vidyapeeth Vishwavidyalaya, Indore
Shri Vaishnav Institute of Agriculture
M.Sc. (Ag.) Entomology, II semester

Syllabus

ENT 502 Insect Anatomy and Physiology (2+1)

Course Code	Course Name	TEACHING & EVALUATION SCHEME							
		THEORY			PRACTICAL		L	P	CREDITS
		END SEM University Exam	Two term exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*			
ENT 502	Insect Anatomy, and Physiology	50	30	0	15	5	2	1	3

Legends: **L** - Lecture; **P** – Practical;

*Teacher Assessment shall be based on following components: Quiz / Assignment / Project / Participation in Class etc.

Aim of the course

To impart knowledge about the anatomy and physiology of insect body systems; nutritional physiology; and their applications in entomology.

Theory

Unit I

Scope and importance of insect physiology; physiology of integument, moulting, chemistry of cuticle, biosynthesis of chitin; growth, hormonal control,

Unit II

Metamorphosis and diapause; pheromone secretion, transmission, perception and reception. Physiology and mechanism of digestion, circulation, respiration, excretion,

Unit III

Reproduction, secretion (exocrine and endocrine glands) and nerve impulse transmission in insects.

Unit IV

Importance of insect nutrition- role of vitamins, proteins, amino acids, carbohydrates, lipids, minerals and other food constituents;

Unit V

Extra and intra-cellular microorganisms and their role in physiology; artificial diets.



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Practical

- Latest analytical techniques for analysis of free amino acids of haemolymph;
- Determination of chitin in insect cuticle;
- Examination and count of insect haemocytes; preparation and evaluation of various diets;
- Consumption, utilization and digestion of natural and artificial diets.

Suggested Readings

Chapman RF. 1998. Insects: Structure and Function. ELBS Ed., London.

Duntson PA. 2004. The Insects: Structure, Function and Biodiversity. Kalyani Publishers, New Delhi.

Gullan PJ and Cranston PS. 2000. The Insects: An Outline of Entomology, 2nd Ed. Blackwell Science, UK.

Kerkut GA and Gilbert LI. 1985. Comprehensive Insect Physiology, Biochemistry and Pharmacology. Vols. I-XIII. Pergamon Press, New York.

Patnaik BD. 2002. Physiology of Insects. Dominant Publishers, New Delhi.

Richards OW and Davies RG. 1977. Imm's General Text Book of Entomology. 10th Ed. Vol. 1. Structure, Physiology and Development. Chapman and Hall, New York.

Simpson SJ. 2007. Advances in Insect Physiology, Vol. 33, Academic Press (Elsevier), London, UK.

Wigglesworth VB. 1984. Insect Physiology. 8th Ed. Chapman and Hall, New York.

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ENT 503 Insect Taxonomy 1+2

Course Code	Course Name	TEACHING & EVALUATION SCHEME							
		THEORY			PRACTICAL		L	P	CREDITS
		END SEM University Exam	Two term exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*			
ENT 503	Insect Taxonomy	50	30	0	15	5	1	2	3

Legends: L - Lecture; P – Practical;

*Teacher Assessment shall be based on following components: Quiz / Assignment / Project / Participation in Class etc.

Aim of the course:

To sensitize the students on the theory and practice of classifying organisms (with special reference to animals) and the rules governing the same. 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 with an emphasis on the practical aspects.

Theory

Unit I

History of insect classification; principles of systematics and its importance. Identification, purpose, methods character matrix, taxonomic keys. Descriptionssubjects of descriptions, characters, nature of characters, analogy v/s homology, parallel v/s convergent evolution, intraspecific variation in characters, polythetic and polymorphic taxa, sexual dimorphism.

Unit II

Brief evolutionary history of insectsintroduction to phylogeny of insects and Classification of Superclass Hexapoda – Classes – Ellipura (Collembola, Protura), Diplura and Insecta- and the Orders contained. International Code of Zoological Nomenclature, Phylocode, its brief explanation and uses. Process of speciation and interbreeding allopatric species.

Unit III

Molecular systematics, DNA barcoding, karyological and biochemical approaches in taxonomy. Insect labeling protocols and procedures. Distinguishing characters, general biology, habits and habitats of insect orders and economically important families contained in them. Collembola, Protura, Diplura. Class Insecta: Subclass Apterygota – Archaeognatha, Thysanura. Subclass: Pterygota, Division Palaeoptera – Odonata and Ephemeroptera.



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Unit IV

Distinguishing characters, general biology, habits and habitats of insect orders and economically important families contained in them (Continued). Division: Neoptera: Subdivision: Orthopteroid and Blattoid Orders (=Oligoneoptera: Plecoptera, Blattodea, Isoptera, Mantodea, Grylloblattodea, Dermaptera, Orthoptera, Phasmatodea, Mantophasmatodea, Embioptera, Zoraptera), Subdivision: Hemipteroid Orders (=Paraneoptera): Psocoptera, Phthiraptera, Thysanoptera and Hemiptera.

Unit V

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

Practical

- 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, Phthiraptera, Neuroptera, Coleoptera, Diptera, Lepidoptera and Hymenoptera;
- Field visits to collect insects of different orders

Suggested Reading

CSIRO 1990. The Insects of Australia: A Text Book for Students and Researchers. 2nd Ed. Vols. I and II, CSIRO. Cornell Univ. Press, Ithaca.

Freeman S and Herron JC. 1998. Evolutionary Analysis. Prentice Hall, New Delhi.

Gullan PJ and Cranston PS. 2010. The Insects: An outline of Entomology. 4th Ed. Wiley-Blackwell Publications, West Sussex, UK.

Mayr E. 1971. Principles of Systematic Zoology. Tata McGraw Hill, New Delhi.

Richards OW and Davies RG. 1977. Imm's General Text Book of Entomology. 10th Ed. Chapman and Hall, London.

Ross HH. 1974. Biological Systematics. Addison Wesley Publ. Company.

Triplehorn CA and Johnson NF. 1998. Borror and DeLong's Introduction to the Study of Insects. 7th Ed. Thomson/ Brooks/ Cole, USA/ Australia

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ENT 505 Biological Control of Crop Pests and Weeds 2+1

Course Code	Course Name	TEACHING & EVALUATION SCHEME							
		THEORY			PRACTICAL		L	P	CREDITS
		END SEM University Exam	Two term exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*			
ENT 505	Biological Control of Crop Pests and Weeds	50	30	0	15	5	2	1	3

Legends: L - Lecture; P – Practical;

*Teacher Assessment shall be based on following components: Quiz / Assignment / Project / Participation in Class etc.

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

History of insect pathology, infection of insects by bacteria, fungi, viruses, protozoa, rickettsiae, spiroplasma and nematodes. Biology, adaptation, host seeking behaviour of predatory and parasitic groups of insects. Role of insect pathogenic nematodes, viruses, bacteria, fungi, protozoa, etc., their mode of action.

Unit III

Biological control of weeds using insects. Epizootiology, symptomatology and etiology of diseases caused by the above and the factors controlling these. Defense mechanisms in insects against pathogens. Mass production of quality bio-control agents- techniques, formulations, economics, field release/ application and evaluation.

Unit IV

Development of insectaries, their maintenance. Successful biological control projects, analysis, trends and future possibilities of biological control. Importation of natural enemies-



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Quarantine regulations, biotechnology in biological control. Semiochemicals in biological control.

Unit V

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 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

Burges HD & Hussey NW. (Eds). 1971. Microbial Control of Insects and Mites. Academic Press, London.

De Bach P. 1964. Biological Control of Insect Pests and Weeds. Chapman & Hall, New York.

Dhaliwal GS & Arora R. 2001. Integrated Pest Management: Concepts and Approaches. Kalyani Publ., New Delhi.

Gerson H & Smiley RL. 1990. Acarine Biocontrol Agents – An Illustrated Key and Manual. Chapman & Hall, New York.

Huffaker CB & Messenger PS. 1976. Theory and Practices of Biological Control. Academic Press, London.

Ignacimuthu SS & Jayaraj S. 2003. Biological Control of Insect Pests. Phoenix Publ., New Delhi.

Saxena AB. 2003. Biological Control of Insect Pests. Anmol Publ., New Delhi.

Van Driesche & Bellows TS. Jr. 1996. Biological Control. Chapman & Hall, New York.

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ENT 506 Toxicology of Insecticides 2+1

Course Code	Course Name	TEACHING & EVALUATION SCHEME							
		THEORY			PRACTICAL		L	P	CREDITS
		END SEM University Exam	Two term exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*			
ENT 506	Toxicology of Insecticides	50	30	0	15	5	2	1	3

Legends: L - Lecture; P – Practical;

*Teacher Assessment shall be based on following components: Quiz / Assignment / Project / Participation in Class etc.

Objective

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; categorization of insecticides on the basis of toxicity – criteria for bees, beneficial insects and other insects in general; structure and mode of action of organochlorines, organophosphates, carbamates, pyrethroids, tertiary amines, neonicotinoids, oxadiazines, phenyl pyrazoles, insect growth regulators, microbials, botanicals, new promising compounds/ new insecticide molecules; nanopesticides; drawbacks of insecticide abuse.

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. bioassay definition, objectives, criteria, factors, problems and solutions.

Unit IV

Insecticide metabolism; insect-pest resistance to insecticides; mechanisms and types of resistance; insecticide resistance management and pest resurgence.



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Unit V

Insecticide residues, their significance and environmental implications; procedures of insecticide residue analysis. Insecticide Act, registration procedures, label claim, and quality control of insecticides; safe use of insecticides; diagnosis and treatment of insecticide poisoning.

Practical

- Insecticide formulations and mixtures;
- Laboratory and field evaluation of bio-efficacy of insecticides;
- Bioassay techniques; • Probit analysis;
- Evaluation of insecticide toxicity;
- Toxicity to beneficial insects;
- Pesticide appliances;
- Working out doses and concentrations of pesticides;
- Procedures of residue analysis.

Suggested Readings

Chattopadhyay SB. 1985. Principles and Procedures of Plant Protection. Oxford & IBH, New Delhi.

Dodia DA, Petel IS and Petal GM. 2008. Botanical Pesticides for Pest Management. Scientific Publisher (India), Jodhpur.

Dovener RA, Mueninghoff JC and Volgar GC. 2002. Pesticides formulation and delivery systems: meeting the challenges of the current crop protection industry. ASTM, USA

Gupta HCL. 1999. Insecticides: Toxicology and Uses. Agrotech Publ., Udaipur.

Ishaaya I and Degheele (Eds.). 1998. Insecticides with Novel Modes of Action. Narosa Publ. House, New Delhi.

Ishaaya I and Degheele D. 1998. Insecticides with Novel Modes of Action: Mechanism and Application. Narosa Publishing House, New Delhi.

Krieger RI. 2001. Handbook of Pesticide Toxicology. Vol-II. Academic Press. Orlando Florida.

Mathews GA. 2002. Pesticide Application Methods. 4th Ed. Intercept. UK.

Matsumura F. 1985. Toxicology of Insecticides. Plenum Press, New York.

Otto D and Weber B. 1991. Insecticides: Mechanism of Action and Resistance. Intercept Ltd., UK.

Pedigo LP and Marlin ER. 2009. Entomology and Pest Management, 6th Edition, Pearson Education Inc., Upper Saddle River, New Jersey 07458, U.S.A.



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Perry AS, Yamamoto I, Ishaaya I and Perry R. 1998. Insecticides in Agriculture and Environment. Narosa Publ. House, New Delhi.

Prakash A and Rao J. 1997. Botanical Pesticides in Agriculture. Lewis Publication, New York.

Roy NK. 2006. Chemistry of Pesticides. Asia Printograph Shahdara Delhi.

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PL PATH 503 Plant Pathogenic Prokaryotes 2+1

Course Code	Course Name	TEACHING & EVALUATION SCHEME							
		THEORY			PRACTICAL		L	P	CREDITS
		END SEM University Exam	Two term exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*			
PL PATH 503	Plant Pathogenic Prokaryotes	50	30	0	15	05	2	1	3

Legends: L - Lecture; P – Practical;

*Teacher Assessment shall be based on following components: Quiz / Assignment / Project / Participation in Class etc.

Objective

To introduce the subject of Plant Pathology, its concepts and principles.

Theory

Unit I

Prokaryotic cell: History and development of Plant bacteriology, history of plant bacteriology in India. Evolution of prokaryotic life, Prokaryotic cytoskeletal proteins. Structure of bacterial cell. Structure and composition of gram negative and gram positive cell wall; synthesis of peptidoglycan; Surface proteins; Lipopolysaccharide structure; Membrane transport; fimbriae and pili (Type IV pili); Mechanism of flagellar rotatory motor and locomotion, and bacterial movement; Glycocalyx (Slayer; capsule); the bacterial chromosomes and plasmids; Operon and other structures in cytoplasm; Morphological feature of fastidious bacteria, spiroplasmas and Phytoplasmas

Unit II

Growth and nutritional requirements. Infection mechanism, role of virulence factors in expression of symptoms. Survival and dispersal of phytopathogenic prokaryotes.

Unit III

Taxonomy of phytopathogenic prokarya: Taxonomic ranks hierarchy; Identification, Classification and nomenclature of bacteria, phytoplasma and spiroplasma. The codes of Nomenclature and characteristics. Biochemical and molecular characterization of phytopathogenic prokaryotes. pathogens.

Unit IV

Variability among phytopathogenic prokarya: general mechanism of variability (mutation); specialized mechanisms of variability (sexual like process in bacteria conjugation; transformation; transduction); and horizontal gene transfer.



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Unit V

Bacteriophages, L form of bacteria, plasmids and bdellovibrios: Structure; Infection of host cells; phage multiplication cycle; Classification of phages, Use of phages in plant pathology/ bacteriology, Lysogenic conversion; H Plasmids and their types, plasmid borne phenotypes. Introduction to bacteriocins. Strategies for management of diseases caused by phytopathogenic prokaryotes

Practical

- Study of symptoms produced by phytopathogenic prokaryotes;
- Isolation, enumeration, purification, identification and host inoculation of phytopathogenic bacteria;
- Stains and staining methods;
- Biochemical and serological characterization;
- Isolation of genomic DNA plasmid;
- Use of antibacterial chemicals/ antibiotics;
- Isolation of fluorescent Pseudomonas;
- Preservation of bacterial cultures;
- Identification of prokaryotic organisms by using 16S rDNA, and other gene sequences;
- Diagnosis and management of important diseases caused by bacteria and mollicutes.

Suggested Readings

Goto M. 1990. Fundamentals of Plant Bacteriology. Academic Press, New York.

Jayaraman J and Verma JP. 2002. Fundamentals of Plant Bacteriology. Kalyani Publishers, Ludhiana.

Mount MS and Lacy GH. 1982. Phytopathogenic Prokaryotes. Vols. I, II Academic Press, New York.

Salle AJ. 1979. Fundamental Principles of Bacteriology 7th edn. Verma JP,

Varma A and Kumar D. (Eds). 1995. Detection of Plant Pathogens and their Management. Angkor Publ., New Delhi.

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PGS 504 Basic Concepts in Laboratory Techniques 0+1

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		THEORY			PRACTICAL		L	P	CREDITS
		END SEM University Exam	Two term exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*			
PGS 504	Basic Concepts In Laboratory Techniques	00	00	00	60	40	0	1	1

Legends: L - Lecture; P – Practical;

*Teacher Assessment shall be based on following components: Quiz / Assignment / Project / Participation in Class etc.

Objective

To acquaint the students about the basics of commonly used techniques in laboratory.

Practical

- Safety measures while in Lab;
- Handling of chemical substances;
- Use of burettes, pipettes, measuring cylinders, flasks, separatory funnel, condensers, micropipettes and vaccumets;
- Washing, drying and sterilization of glassware;
- Drying of solvents/ chemicals;
- Weighing and preparation of solutions of different strengths and their dilution;
- Handling techniques of solutions;
- Preparation of different agro-chemical doses in field and pot applications;
- Preparation of solutions of acids;
- Neutralisation of acid and bases;
- Preparation of buffers of different strengths and pH values;
- Use and handling of microscope, laminar flow, vacuum pumps, viscometer, thermometer, magnetic stirrer, micro-ovens, incubators, sandbath, waterbath, oilbath;
- Electric wiring and earthing;
- Preparation of media and methods of sterilization;
- Seed viability testing, testing of pollen viability;



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- Tissue culture of crop plants;
- Description of flowering plants in botanical terms in relation to taxonomy.

Suggested Readings

1. Furr AK. 2000. CRC Hand Book of Laboratory Safety. CRC Press.
2. Gabb MH and Latchem WE. 1968. A Handbook of Laboratory Solutions. Chemical Publ. Co.

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PGS 505 Agricultural Research, Research Ethics and Rural Development Programmes 1+0

Course Code	Course Name	TEACHING & EVALUATION SCHEME							
		THEORY			PRACTICAL		L	P	CREDITS
		END SEM University Exam	Two term exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*			
PGS 505	Agricultural Research, Research Ethics And Rural Development Programmes	50	40	10	0	0	1	0	1

Legends: L - Lecture; P – Practical;

*Teacher Assessment shall be based on following components: Quiz / Assignment / Project / Participation in Class etc.

Objectives

To enlighten the students about the organization and functioning of agricultural research systems at national and international levels, research ethics, and rural development programmes and policies of Government.

Theory

Unit I

History of agriculture in brief; Global agricultural research system: need, scope, opportunities; Role in promoting food security, reducing poverty and protecting the environment; National Agricultural Research Systems (NARS) and Regional Agricultural Research Institutions;

Unit II

Consultative Group on International Agricultural Research (CGIAR): International Agricultural Research Centres (IARC), partnership with NARS, role as a partner in the global agricultural research system, strengthening capacities at national and regional levels; International fellowships for scientific mobility.

Unit III

Research ethics: research integrity, research safety in laboratories, welfare of animals used in research, computer ethics, standards and problems in research ethics. Concept and connotations of rural development, rural development policies and strategies.



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Unit IV

Rural development programmes: Community Development Programme, Intensive Agricultural District Programme, Special group – Area Specific Programme, Integrated Rural Development Programme (IRDP) Panchayati Raj Institutions, Co-operatives,

Unit V

Voluntary Agencies/ Non-Governmental Organisations. Critical evaluation of rural development policies and programmes. Constraints in implementation of rural policies and programmes.

Suggested Readings

Gupta HK. 2003. Disaster Management. Indian National Science Academy. Orient Blackswan.

Hodgkinson PE & Stewart M. 1991. Coping with Catastrophe: A Handbook of Disaster Management. Routledge.

Sharma VK. 2001. Disaster Management. National Centre for Disaster Management, India.

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