Shri Vaishnav Vidyapeeth Vishwavidyalaya, Indore
Shri Vaishnav Institute of Agriculture
Ph.D. (Ag.) Entomology, I semester

Syllabus

A.1.Research Methodology (PHDAS 101)

Course code	Course Name	TEACHING & EVALUATION SCHEME							
		THEORY			PRACTICAL		L	P	CREDITS
		END SEM University Exam	Mid Term Exam	Teachers Assessment*	END SEM University Exam	Teacher's Assessment*			
PHDAS 101	Research Methodology	60	-	40	0	0	3	0	3

1. Legends: L - Lecture; **P –** Practical
2. *Teacher Assessment shall be based on following components: Quiz / Assignment / Project / Participation in Class.

A1.Research Methodology (PHDAS 101)

Module 1: Introduction to Research Methods: Role and objectives of research, types of research and various research design (exploratory, descriptive, experimental and diagnostic research), research process: Overview, Problems encountered by researcher. Experimental research design will comprise of Completely Randomized Design, Latin Square Design and Factorial Design. Limitations of RM: Ethics in Research, Philosophical issues in Research.

Module 2: Data and their Collection: Collection, Organization, Presentation, Analysis and Interrelation of Primary and Secondary Data. Measurement in research, measurement scales, sources of errors in measurement, Techniques of developing measurement tools, classification and testing (reliability, verification and validity) scales, Designing questionnaires and interviews Sampling , Sampling Methods, Sampling Plans, Sampling Error, Sampling Distributions : Theory and Design of Sample Survey, Census Vs Sample Enumerations, Objectives and Principles of Sampling, Types of Sampling, Sampling and Non-Sampling Errors.

Module 3: Numerical Methods and Statistical Analysis Curve fitting (least square), solution of polynomial equation, numerical integration (Trapezoidal rule, Simpson's rule, Gaussian qudrature), solution of ordinary differential equations (Euler's method, Runge-Kutta method, predictor-corrector method), matrix multiplication, inversion and diagonalisation.

References

- Kumar, R.(2006).**Research Methodology-A Step- By- Step Guide for Beginners**, Delhi: Pearson Education.
- Montgomery, D. C. (2007).**Design & Analysis of Experiments**. India: Wiley.
- Kothari, C. R. (2004). **Research Methodology: Methods and Techniques**. New Delhi: New Age International.

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Review of Literature (PHDA 102)

Course code	Course Name	TEACHING & EVALUATION SCHEME							
		THEORY			PRACTICAL		L	P	CREDITS
		END SEM University Exam	Mid Term Exam	Teachers Assessment*	END SEM University Exam	Teacher's Assessment*			
PHDA 102	Review of Literature	60	-	40	0	0	2	0	2

1. Legends: L - Lecture**; P –** Practical
2. *Teacher Assessment shall be based on following components: Quiz / Assignment / Project / Participation in Class.

A.2.Review of Literature (PHDA102)

Course Overview: *The objective of this course is to help the candidate to comprehend his/her broad field of research and be academically sound to carry out his research work. Understand the basic philosophical assumptions underlying research literature reviews for different purposes, including what, why, when, for whom, and how? Be able to manage the process of conducting a literature review, including reading, note taking strategies, coding/reference management, synthesizing and writing literature results. Be able to write a quality literature review with variations in references*

Course Content

Module 1: **Understanding Review of literature:** Relevance, Approach and Applications; Developing an outline for the literature review; Formulate key questions for a review. Organizing a literature search**:** Identify which literature bases to search; Developing the theoretical basis for the Research Question; Searching for, locating and organizing relevant professional literature

Module 2: **Conducting the Review:** Abstract relevant information from appropriate studies in a systematic manner; critically reviewing the literature; Rate the scientific quality of each study and the level of evidence for each question;

Module 3: **Synthesizing the Review:** Create evidence tables and summary tables; interpret the pattern of evidence interms of strength and consistency; Summarize the studies' findings. Writing the review: Writing a first draft; Writing references and citations; Obtaining, giving, and making productive use of feedback; the redrafting process; Professional formatting.

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A.3.Computer Applications (PHDA 103)

Course code	Course Name	TEACHING & EVALUATION SCHEME							
		THEORY			PRACTICAL		L	P	CREDITS
		END SEM University Exam	Mid Term Exam	Teachers Assessment*	END SEM University Exam	Teacher's Assessment*			
PHDA 103	Computer Applications	60	-	40	0	0	2	0	2

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

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

Course Overview: *The candidate should gain sufficient practical knowledge for use of computer and computer software for use in research work.*

Contents

Module 1: Basic knowledge of application software's in MS- Office with focus on MS-Word- its features and applications related to presentation of text in decent format and saving the same for further use. The practical knowledge of this software should enable the candidate to type and prepare the thesis
in a presentable format.MS-Excel- construction of worksheet and inserting data according to its characteristics, use of statistical tools and their presentation in the form of charts and graphs.

Module 2: Use of Internet for research work and exploring various websites and search engines for collecting quality literature review and secondary data etc. related to thesis work.

Module 3: MS- Power point – create power point presentation on a topic related to the theme of thesis and use of different presentation techniques. Use of SPSS – method of preparing data sheet and entering data according to its characteristics , use of various statistical tools on SPSS.

Research and Publication Ethics (RPE) (PHDA 104)

Course code	Course Name	TEACHING & EVALUATION SCHEME							
		THEORY			PRACTICAL		L	P	CREDITS
		END SEM University Exam	Mid Term Exam	Teachers Assessment*	END SEM University Exam	Teacher's Assessment*			
PHDA 104	Research and Publication Ethics	60	-	40	0	0	2	0	2

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

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

A.4.Research and Publication Ethics (RPE) (PHDA 104)

Module 1: Philosophy And Ethics-Introduction to philosophy: definition, nature and scope, concept, branches. Ethics: definition, moral philosophy, nature of moral judgments and reactions.
Scientific Conduct- Ethics with respect to science and research. Intellectual honesty and research integrity. Scientific misconducts: Falsification, Fabrication, and Plagiarism (FFP).Redundant publications: duplicate and overlapping publications, salami slicing. Selective reporting and misrepresentation of data

Module 2: Publication Ethics-Publication ethics: Definition, introduction and importance.
Best practices / standards setting initiatives and guidelines: COPE, WAME, etc. Conflicts of interest.
Publication misconduct: definition, concept, problems that lead to unethical behavior and vice versa, types. Violation of publication ethics, authorship and contributor ship. Identification of publication misconduct, complaints and appeals. Predatory publishers and journals.
Open Access Publishing- Open access publications and initiatives. SHERPA/RoMEO online resource to check publisher copyright & self-archiving policies. Software tool to identify predatory publications developed by SPPU. Journal finder / journal suggestion tools viz. JANE, Elsevier Journal Finder, Springer Journal Suggested, etc.

Module 3: Publication Misconduct, Group Discussions-Subject specific ethical issues, FFP, authorship. Conflicts of interest. Complaints and appeals: examples and fraud from India and abroad. Software tools- Use of plagiarism software like **Tumitin, Urkund And Other Open**

Source Software Tools. Data Bases And Research Metrics, Databases- Indexing databases Citation databases: Web of Science, Scopus, etc. Research Metrics- Impact Factor of journal as per Journal Citation Report, SNIP, SIR, IPP, Cite Score. Metrics: h-index, g index, i10 index, altmetrics.

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ENT 601: Insect Phylogeny and Systematics (2+1)

Course code	Course Name	TEACHING & EVALUATION SCHEME							
		THEORY			PRACTICAL		L	P	CREDITS
		END SEM University Exam	Mid Term Exam	Teachers Assessment*	END SEM University Exam	Teacher's Assessment*			
ENT 601	Insect Phylogeny and Systematics	60	00	20	15	05	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 familiarize the students with different schools of classification, phylogenetics, classical and molecular methods, evolution of different groups of insects. Detailed study about the International Code of Zoological Nomenclature; ethics and procedure for taxonomic publications.

Theory

Unit I

Detailed study of three schools of classification- numerical, evolutionary and cladistic. Methodologies employed. Development of phenograms, cladograms, molecular approaches for the classification of organisms.

Unit II

Methods in identification of homology. Species concepts, speciation processes and evidences. Zoogeography. Study of different views on the evolution of insects- alternative phylogenies of insects: Kukalova Peck and Kristensen.

Unit III

Fossil insects and evolution of insect diversity over geological times. Detailed study of International Code of Zoological Nomenclature, including appendices to ICZN; scientific ethics. Nomenclature and documentation protocols and procedures; report preparation on new species; deposition of holotypes.

Unit IV

Paratypes, and insect specimens as a whole in national and international repositories – requirements and procedures. Concept of Phylocode and alternative naming systems for animals. A detailed study of selected representatives of taxonomic publications – small publications of species descriptions, works on revision of taxa, monographs, check lists, faunal volumes, etc.

Unit V

Websites related to insect taxonomy and databases. Molecular taxonomy, barcoding species and the progress made in molecular sytematics.

Practical

• Collection, curation and study of one taxon of insects- literature search, compilation of a checklist, study of characters, development of character table, and 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 polarization for developing cladograms and use of computer programmes to develop cladograms.

Suggested Readings

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

Dakeshott J and Whitten MA. 1994. Molecular Approaches to Fundamental and Applied Entomology. Springer-Verlag, Berlin.

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

Hennig W. 1960. Phylogenetic Systematics. Urbana Univ. Illinois Press, USA.

Hoy MA. 2003. Insect Molecular Genetics: An Introduction to Principles and Applications. 2nd Ed. Academic Press, New York.

Mayr E and Ashlock PD. 1991. Principles of Systematic Zoology. 2nd Ed. McGraw Hill, New York.

Mayr E.1969. Principles of Systematic Zoology. McGraw-Hill, New York.

Quicke DLJ. 1993. Principles and Techniques of Contemporary Taxonomy. Blackie Academic and Professional, London.

Ross HH. 1974. Biological Systematics. Addison Wesley Publ. Co., London.

Wiley EO. 1981. Phylogenetics: The Theory and Practices of Phylogenetic Systematics for Biologists. Columbia Univ. Press, USA.

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ENT- 602 Insect Physiology and Nutrition (2+1)

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		THEORY			PRACTICAL		L	P	CREDITS
		END SEM University Exam	Mid Term Exam	Teachers Assessment*	END SEM University Exam	Teacher's Assessment*			
ENT- 602	Insect Physiology and Nutrition	60	00	20	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.

Aim of the course

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, hardening of cuticlde.

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;

Unit III

Physiology of excretion and osmoregulation, water conservation mechanisms. Detailed physiology of nervous system, transmission of nerve impulses, neurotransmitters and modulators.

Unit IV

Production of receptor potentials in different types of sensilla, pheromones and other semiochemicals in insect life, toxins and defense mechanisms. Endocrine system and insect hormones, physiology of insect growth and development- metamorphosis, polymorphism and diapause.

Unit V

Insect behaviour in IPM- Concept of super-normal stimuli and behavioural manipulation as potential tool in pest management, use of semio-chemicals, auditory stimuli and visual signals in pest management.

Practical

• Preparation of synthetic diets for different groups of insects;

• Rearing of insects on synthetic, semi-synthetic and natural diets;

• Determination of co-efficient of utilization;

• Qualitative and quantitative profile of bio-molecules: practicing analytical techniques for analysis of free amino acids of haemolymph;

• Zymogram analyses of amylase;

• Determination of chitin in insect cuticle;

• Examination and count of insect haemocytes.

Suggested Readings

Ananthkrishnan TN. (Ed.). 1994. Functional Dynamics of Phytophagous Insects. Oxford and IBH, New Delhi.

Bernays EA and Chapman RF. 1994. Host-Plant Selection by Phytophagous Insects. Chapman and Hall, London.

Kerkut GA and Gilbert LI. 1985. Insect Physiology, Biochemistry and Pharmacology. Vols. IXIII. Pergamon Press, Oxford, New York.

Muraleedharan K. 1997. Recent Advances in Insect Endocrinology. Association for Advancement of Entomology, Trivandrum, Kerala.

Rockstein, M. 1978. Biochemistry of Insects, Academic Press.

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

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ENT- 603 Insect Ecology and Diversity (2+1)

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		THEORY			PRACTICAL		L	P	CREDITS
		END SEM University Exam	Mid Term Exam	Teachers Assessment*	END SEM University Exam	Teacher's Assessment*			
ENT 603	Insect Ecology and Diversity	60	00	20	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.

Aim of the course:
To impart advanced practical knowledge of causal factors governing the distribution and abundance of insects and the evolution of ecological characteristics. Study insect-plant interactions; get acquainted with biodiversity and conservation.

Theory

Unit I

Characterization of distribution of insects- Indices of Dispersion, Taylor's Power law. Island Biogeography. Population dynamics- Life tables, Leslie Matrix, Stable age distribution, Population projections. Predator-Prey Models- Lotka-Volterra and Nicholson-Bailey Model. Crop Modeling- an introduction.

Unit II

Insect Plant Interactions. Fig-figwasp mutualism and a quantitative view of types of associations. Role of insects in the environment. Adaptations to terrestrial habitats. Evolution of insect diversity and role of phytophagy as an adaptive zone for increased diversity of insects. Evolution of resource harvesting organs, resilience of insect taxa and the sustenance of insect diversity- role of plants. Herbivory, pollination, predation, parasitism.

Unit III

Modes of insect-plant interaction, tri-trophic interactions. Evolution of herbivory, monophagy vs polyphagy. Role of plant secondary metabolites. Meaning of stress- plant stress and herbivory. Consequences of herbivory to plant fitness and response to stress. Constitutive and induced plant defenses. Host seeking behavior of parasitoids. Biodiversity and Conservation- RET species, Ecological Indicators.

Unit IV

Principles of Population genetics, Hardy Weinberg Law, Computation of Allelic and Phenotypic frequencies, Fitness under selection, Rates of Evolution under selection. Foraging Ecology- Optimal foraging theory, Marginal Value Theorem, and Patch departure rules,

central place foraging, Mean-variance relationship and foraging by pollinators, Nutritional Ecology.

Unit V

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

• Methods of data collection under field conditions;

• Assessment of distribution parameters, Taylor's power law, Iwao's patchiness index, Index of Dispersion, etc.;

• Calculation of sample sizes by different methods;

• Fitting Poisson and Negative Binomial distributions and working out the data transformation methods;

• Hardy-Weinberg Law, Computation of Allelic and Phenotypic Frequencies – Calculation of changes under selection, Demonstration of genetic drift;

• Assessment of Patch Departure rules. Assessment of Resource size by female insects using a suitable insect model, fruit flies/ Goniozus/ Female Bruchids, etc.;

• A test of reproductive effort and fitness;

• Construction of Life tables and application of Leslie Matrix – population projections, Stable age distribution;

• Exercises in development of Algorithms for crop modeling;

Suggested Readings

Barbosa P and Letourneau DK. (Eds.). 1988. Novel Aspects of Insect-Plant Interactions. Wiley, London.

Elizabeth BA and Chapman RF. 1994. Host-Plant Selection by Phytophagous Insects. Chapman and Hall, New York.

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

Gotelli NJ and Ellison AM. 2004. A Primer of Ecological Statistics. Sinauer Associates, Sunderland, MA.

Gotelli NJ. 2001. A Primer of Ecology. 3rd Ed., Sinauer Associates, Sunderland, MA, USA.

Krebs C. 1998. Ecological Methodology. 2nd Ed. Benjamin-Cummings Publ. Co., New York.

Krebs CJ. 2001 Ecology: The Experimental Analysis of Distribution and Abundance. 5th Ed. Benjamin-Cummings Publ. Co., New York.

Magurran AE. 1988. Ecological Diversity and its Measurement. Princeton University Press, Princeton.

Real LA and Brown JH. (Eds.). 1991. Foundations of Ecology: Classic Papers with Commentaries. University of Chicago Press, USA.

Southwood TRE and Henderson PA. 2000. Ecological Methods. 3rd Ed. Wiley Blackwell, London.

Strong DR, Lawton JH and Southwood R. 1984. Insects on Plants: Community Patterns and Mechanism. Harward University Press, Harward.

Wratten SD and Fry GLA. 1980. Field and Laboratory Exercises in Ecology. Arnold Publ., London.

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PL PATH 602 Advances in Plant Virology 2+1

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		THEORY			PRACTICAL		L	P	CREDITS
		END SEM University Exam	Mid Term Exam	Teachers Assessment*	END SEM University Exam	Teacher's Assessment*			
PL PATH 602	Advances in Plant Virology	60	00	20	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.

Aim of the course:

To educate about the advanced techniques and new developments in plant virology.

Theory

Unit I

Origin, evolution and interrelationship with animal viruses. Virus morphology, structure, architecture, replication (overview of host and viral components required), assembly and virus specific cytological effects in infected plant cells. Mechanisms leading to the evolution of new viruses/ strains: mutation, recombination, pseudorecombination, component re-assortment, etc.

Unit II

Major vector groups of plant viruses and their taxonomy, virus-vector relationship, molecular mechanism of virus transmission by vectors. Terminologies used in immunology and serology. Classification, structure and functions of various domains of Immunoglobulins. Production of Polyclonal and monoclonal antibodies for detection of viruses.

Unit III

Immuno/ serological assays (Slide agglutination tests, Test tube precipitation test, Double agar diffusion test, ELISA (DAC, DAS, TAS), Dot Immuno Binding Assay, and nucleic acid based assays for detection of plant viruses. Polymerase Chain Reaction based (PCR, reverse transcriptase PCR, multiplex PCR, Nested PCR, Real time/ q PCR) and non PCR based: LAMP, Fluorescent in situ hybridization (FISH), dot blot hybridization.

Unit IV

Plant virus genome organization (General properties of plant viral genome- information content, coding and noncoding regions), replication, transcription and translational strategies of pararetroviruses, geminiviruses, tobamo-, poty-, bromo, cucumo, ilar, tospoviruses, satellite viruses and satellite RNA. Gene expression, regulation and viral promoters.Genetic engineering with plant viruses, viral suppressors, RNAi dynamics and resistant genes. Virus potential as vectors, genetically engineered resistance, transgenic plants.

Unit V

Techniques and application of tissue culture for production of virus free planting materials. Phylogenetic grouping system based on partial/ complete sequences of virus genomes and using of next generation sequencing technology in plant virus discovery.

Practical

• Purification of viruses, SDS-PAGE for molecular weight determination, production of polyclonal antiserum, purification of IgG and conjugate preparation;

• Acquaintance with different serological techniques (i) DAC- ELISA (ii) DAS-ELISA Plant Protection–Plant Pathology 237 (iii) DIBA (iv) Western blots (v) (ab) 2-ELISA. Nucleic acid isolation, DOT-blot, southern hybridization, probe preparation,and autoradiography;

• PCR application and viral genome cloning of PCR products, plasmid purification, enzyme digestion, sequencing, annotation of genes, analysis of viral sequences (use of gene bank, blast of viral sequences and phylogeny);

• Bioinformatics analysis tools for virology (ORF finder, Gene mark, Gene ontology, BLAST, Clustal X/W, Tm pred and Phylogeny programs).

Suggested Readings

Davies 1997. Molecular Plant Virology: Replication and Gene Expression. CRC Press, Florida.

Fauquet et al. 2005. Virus Taxonomy. VIII Report of ICTV. Academic Press, New York.

Gibbs A and Harrison B. 1976. Plant Virology – The Principles. Edward Arnold, London.

Jones P, Jones PG and Sutton JM. 1997. Plant Molecular Biology: Essential Techniques. John Wiley & Sons, New York.

Khan J A and Dijkstra. 2002. Plant Viruses as Molecular Pathogens. Howarth Press, New York.

Maramorosch K, Murphy FA and Shatkin AJ. 1996. Advances in Virus Research. Vol. 46. Academic Press, New York.

Pirone TP and Shaw JG. 1990. Viral Genes and Plant Pathogenesis. Springer Verlag, New York.

Roger Hull. 2002. Mathew's Plant Virology (4th Ed.). Academic Press, New York.

Thresh JM. 2006. Advances in Virus Research. Academic Press, New York.

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