

Proposed
National Education Policy 2020 Inserted Pre-Ph.
D.Course Work for

Doctor of Philosophy
in

Entomology

(Academic Session:2022-23 on wards)



Examine and approved by:
Board of Studies-Entomology
Maharaja Suhel Dev State
University, Azamgarh-
276128, Uttar Pradesh (INDIA)

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Pre-Ph.D.Course work for Ph.D.in Entomology

The Pre-Ph.D.course work for Doctor of Philosophy in Entomology shall comprise of only one semester (i.e.I-semester) in which there shall be three compulsory papers and one major research project.

Distribution of Courses in the I Semester

I-Semester				
Course Code	Type of course	Paper	Title of the course	Credit hr
ENT-601	Compulsory (Major Subject)	I	RECENT TRENDS IN BIOLOGICAL CONTROL & ADVANCED INSECTICIDE TOXICOLOGY	6(4+2)
ENT-602	Compulsory (Major Subject)	II	Ecological approach for Pest Management	6(4+2)
ENT-603	Compulsory (Research Methodology)	III	Research Methodology	4(3+1)
ENT-604	Compulsory (Major Research Project)	--	Major Research Project	Non-credit /qualifying

Note: There research work and Ph.D. thesis shall be completed as per the effective UGC (Minimum Standards and Procedure for Award of Ph. D.) Regulation and accordance with the Ordinance made for same by the university.

Name of the Subject: Entomology					
Course/ paper code:	ENT-601	Course/ paper title:	RECENT TRENDS IN BIOLOGICAL CONTROL & ADVANCED INSECTICIDE TOXICOLOGY	Credit assigned	6(4+2)
Type of course	Compulsory	Semester	I		
Course objective & Outcomes:	Skill improvement of 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. To acquaint the students with the latest advancements in the field of insecticide toxicology, biochemical and physiological target sites of insecticides, and pesticide resistance mechanisms in insects.				
Unit	Topic (Theory)				M.L.
I	Scope of classical biological control and augmentative biocontrol; introduction and handling of natural enemies; nutrition of entomophagous insects and their hosts, dynamics of biocontrol agents vis-à-vis target pest populations. Mass culturing techniques, insectary facilities and equipments, basic standards of insectary, viable mass-production unit, designs, precautions, good insectary practices.				10
II	Colonization, techniques of release of natural enemies, recovery evaluation, conservation and augmentation of natural enemies, survivorship analysis and ecological manipulations, large-scale production of biocontrol agents, bankable project preparation. Scope of genetically engineered microbes and parasitoids in biological control, genetics of ideal traits in biocontrol agents for introgressing and for progeny selections, breeding techniques of biocontrol agents.				15
III	Penetration and distribution of insecticides in insect systems; insecticide selectivity; factors affecting toxicity of insecticides. Biochemical and physiological target sites of insecticides in insects; developments in biorationals, biopesticides and newer molecules; their modes of action and structural – activity relationships; advances in metabolism of insecticides. Joint action of insecticides; activation, synergism and potentiation.				15
IV	Problems associated with pesticide use in agriculture: pesticide resistance mechanisms and resistant management strategies; pest resurgence and outbreaks; persistence and pollution; health hazards and other side effects.				10
V	Estimation of insecticidal residues- sampling, extraction, clean-up and estimation by various methods; maximum residue limits (MRLs) and their fixation; insecticide laws and standards, and good agricultural practices.				10
	Practical				
	Mass rearing and release of some commonly occurring indigenous natural enemies; assessment of role of natural enemies in reducing pest populations; testing side effects of pesticides on natural enemies; effect of semiochemicals on natural enemies, breeding of various biocontrol agents, performance of efficiency analyses on target pests; project document preparation for establishing a viable mass-production unit /insectary. Sampling, extraction, clean-up and estimation of insecticide residues by various methods; calculations and interpretation of data; biochemical and biological techniques for detection of insecticide resistance in insects.				30
Suggested readings including digital platforms	<p>Suggested Readings</p> <p>Burges HD & Hussey NW. (Eds.). 1971. Microbial Control of Insects and Mites. Academic Press, London.</p> <p>Coppel HC & James WM. 1977. Biological Insect Pest Suppression. Springer Verlag, Berlin.</p> <p>De Bach P. 1964. Biological Control of Insect Pests and Weeds. Chapman & Hall, London.</p> <p>Dhaliwal, GS & Koul O. 2007. Biopesticides and Pest Management. Kalyani Publ., New Delhi.</p> <p>Gerson H & Smiley RL. 1990. Acarine Biocontrol Agents – An Illustrated Key and Manual. Chapman & Hall, New York.</p> <p>Huffaker CB & Messenger PS. 1976. Theory and Practices of Biological Control. Academic Press, London.</p> <p>Busvine JR. 1971. A Critical Review on the Techniques for Testing Insecticides. CABI, London.</p> <p>Dhaliwal GS & Koul O. 2007. Biopesticides and Pest Management. Kalyani Publ., New Delhi.</p> <p>Hayes WJ & Laws ER. 1991. Handbook of Pesticide Toxicology. Academic Press, New York.</p> <p>Ishaaya I & Degheele (Eds.). 1998. Insecticides with Novel Modes of Action. Narosa Publ. House, New Delhi.</p> <p>Matsumura F. 1985. Toxicology of Insecticides. Plenum Press, New York.</p> <p>O' Brien RD. 1974. Insecticides Action and Metabolism. Academic Press, New York.</p> <p>Perry AS, Yamamoto I, Ishaaya I & Perry R. 1998. Insecticides in Agriculture and Environment. Narosa Publ. House, New Delhi.</p> <p>Prakash A & Rao J. 1997. Botanical Pesticides in Agriculture. Lewis Publ., New York.</p>				

Name of the Subject: Entomology					
Course/paper code:	ENT-602	Course/paper title:	Ecological approach for Pest Management	Credits assigned	6(4+2)
Type of course					
Course objective & Outcomes:	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. To acquaint the students with recent concepts of integrated pest management; surveillance and data base management; successful national and international case histories of integrated pest management, non-conventional tools in pest management.				
Unit	Topic (Theory)				M.L.
I	Population dynamics- Life tables, Insect Plant Interactions, Herbivory, pollination, predation, parasitism. Modes of insect-plant interaction, tri-trophic interactions. Evolution of herbivory, monophagy vs polyphagy. Role of plant secondary metabolites. Host seeking behavior of parasitoids.				15
II	Biodiversity and Conservation- RET species, Ecological Indicators, 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.				15
III	Principles of sampling and surveillance, Study of case histories of national and international programmes, their implementation, adoption and criticism; global trade and risk of invasive pests; updating knowledge on insect outbreaks and their management.				15
IV	Genetic engineering and new technologies- their progress and limitations in IPM, scope and limitations of bio-intensive and ecological based IPM programmes; application of IPM to farmers, Challenges, needs and future outlook; dynamism of IPM under changing cropping systems and climate; insect pest management.				15
	Practical				
	Methods of data collection under field conditions, Calculation of sample sizes Construction of Life tables, Field visits to understand different ecosystems and to study insect occurrence in these systems. Study about Economic Threshold Level, Economic Injury Level, General Equilibrium Position.				30
Suggested reading including digital platforms	Dhaliwal GS and Arora R. 2003. Integrated Pest Management – Concepts and Approaches. Kalyani Publishers, New Delhi. Dhaliwal GS, Singh R and Chhillar BS. 2006. Essentials of Agricultural Entomology. Kalyani Publishers, New Delhi. Flint MC and Bosch RV. 1981. Introduction to Integrated Pest Management. Springer, Berlin. Koul O and Cuperus GW. 2007. Ecologically Based Integrated Pest Management. CABI, London. Metcalf RL and Luckman WH. 1982. Introduction to Insect Pest Management. John Wiley and Sons, New York. Norris RF, Caswell-Chen EP and Kogan M. 2002. Concepts in Integrated Pest Management. Prentice Hall, New Delhi. Pedigo RL. 1996. Entomology and Pest Management. Prentice Hall, New Delhi. Subramanyam B and Hagstrum DW. 1995. Integrated Management of Insects in Stored Products. Marcel Dekker, New York. Barbosa P and Letourneau DK. (Eds.). 1988. Novel Aspects of Insect-Plant Interactions. Wiley, London. Price PW. 1997. Insect Ecology. 3rd Ed. John Wiley, New York.				

Name of the Subject: Entomology					
Course/ paper code:	ENT-603	Course/ paper title:	Research Methodology	Credit assigned	4(3+1)
Type of course	Compulsory	Semester	I		
Course objective & Outcomes:	The students would be exposed to concepts of statistical methods and statistical inference that would help them in understanding the importance of statistics. The students would be exposed to concepts of Design of Experiments so as to enable them to understand the concepts involved in planning, designing their experiments and analysis of experimental data.				
Unit	Topic (Theory)				M.L.
I	Concept of sampling distribution: chi-square, t and F distributions. Tests of significance based on Normal, chi-square, t and F distributions. Introduction to theory of estimation and confidence-intervals, Simple and multiple correlation coefficient, partial correlation, rank correlation, Simple and multiple linear regression model, test of significance of correlation coefficient and regression coefficients, Coefficient of determination. Introduction to ANOVA: One way and Two Way, Introduction to Sampling Techniques, Introduction to Multivariate Analysis, Transformation of Data. Simple and Multiple linear regressions.				15
II	Need for designing of experiments, characteristics of a good design. Basic principles of designs- randomization, replication and local control. Uniformity trials, size and shape of plots and blocks, Analysis of variance, completely randomized design, randomized block design and Latin square design.				7
III	Split plot and strip plot designs, analysis of covariance and missing plot techniques in randomized block and Latin square designs. Transformations, Balanced Incomplete Block Design, resolvable designs and their applications, Lattice design- concepts, randomization procedure, analysis and interpretation of results. Response surfaces. Combined analysis.				8
IV	Sample survey vs complete enumeration, probability sampling, sample space, sampling design, sampling strategy; Determination of sample size; Confidence- interval; Simple random sampling, Estimation of population proportion, Stratified random sampling, Proportional allocation and optimal allocation, Inverse sampling. Ratio, Product and regression methods of estimation, Cluster sampling, Systematic sampling, Multistage sampling with equal probability, Separate and combined ratio estimator, Double sampling, Successive sampling –two occasions. Unbiased ratio type estimators				15
	Practical				
VI	Large sample tests, testing of hypothesis based on exact sampling distributions ~ chi square, t and F. ANOVA. Uniformity trial data analysis, formation of plots and blocks, Analysis of data obtained from CRD, RBD, LSD. Analysis of factorial experiments. Analysis with missing data. Split plot and strip plot designs. Determination of sample size and selection of sample. Simple random sampling, Inverse sampling, stratified random sampling, Cluster sampling, systematic sampling; Ratio and regression methods of estimation; Double sampling, multi-stage sampling, Imputation methods				15
Suggested readings including digital platform	Goon A.M, Gupta M.K and Dasgupta B. 1977. An Outline of Statistical Theory. Vol. I. The World Press. Cochran WG and Cox GM. 1957. Experimental Designs. 2nd Ed. John Wiley. Dean AM and Voss D. 1999. Design and Analysis of Experiments. Springer. Montgomery DC. 2012. Design and Analysis of Experiments, 8th Ed. John Wiley. Federer WT. 1985. Experimental Designs. MacMillan. Fisher RA. 1953. Design and Analysis of Experiments. Oliver & Boyd. Nigam AK and Gupta VK. 1979. Handbook on Analysis of Agricultural Experiments. IASRI Publ. Pearce SC. 1983. The Agricultural Field Experiment: A Statistical Examination of Theory and Practice.				

