

**Department of Entomology  
Faculty of Agricultural Sciences  
University of the Punjab, Lahore  
Course Outline**



<b>Programme</b>	B.Sc. (Hons) Agriculture (Major: Entomology)	<b>Course Code</b>	ENT-312	<b>Credit Hours</b>	3 (2-1)
<b>Course Title</b>	<b>BIOLOGICAL CONTROL OF INSECT PESTS</b>				
<b>Course Introduction</b>					
<p>Biological control is one of the emerging control strategies being used against insect pests. This course is of graduate-level related to biological control. The course aims to elaborate the introduction, concept, history and scope, ecological basis of biological control, natural enemies: predators, parasitoids and insect pathogens (mode of action, application, epizootics), advantages and disadvantages, characteristics of bio-control agents, procedure of biological control: introduction; enhancement of bio control agents (introduction, conservation, mass culture, augmentation, release, monitoring and importation); rearing techniques of bio-control agents and their host insects; role of biological control in IPM. The course will enable the students, know about principles and practices of biological control.</p>					
<b>Learning Outcomes</b>					
<p>On the completion of the course, the students will have gained the ability to:</p> <ol style="list-style-type: none"> <li>1. The ecological basis of biological control and its utility in sustainable pest management</li> <li>2. Host-parasite (or pathogen) relationships and biology of various biological control agents of insects, mites, slugs, nematodes and weeds</li> <li>3. Methods of mass-production, formulation and delivery of various biological control agents</li> <li>4. Factors affecting the successes and failures of biological control agents and ways to manage them to achieve predicative results</li> <li>5. Research approaches to discover, assess, and develop</li> </ol>					
<b>Course Content (Theory)</b>					<b>Assignments/Readings</b>
<b>Week 1</b>	<b>Unit-I</b>				
	1.1. Introduction 1.1.1. Definition and history of biological control 1.1.2. Importance of biological control in pest management				
<b>Week 2</b>	<b>Unit-II</b>				
	2.1. Ideal characteristics of a biological control agent. 2.2. Biology and diversity of parasitoids.				
<b>Week 3</b>	<b>Unit-III</b>				
	3.1. Biology and diversity of predators.				

	3.2. Biology and diversity of weed control agents.	
<b>Week 4</b>	<b>Unit-IV</b> 4.1. Biology and diversity of entomopathogens	
	4.2. Biology and diversity of entomopathogens (cont....)	
<b>Week 5</b>	<b>Unit-V</b> 5.1. Mechanism of action of entomopathogens	
	5.2. Mechanism of action of entomopathogens (cont....)	
<b>Week 6</b>	<b>Unit-VI</b> 6.1. Classical biological control	
	6.2. Conservation biological control	
<b>Week 7</b>	<b>Unit-VII</b> 7.1. Augmentation biological control	
	7.2. Biological control of weeds	
<b>Week 8</b>	<b>Unit-VIII</b> 8.1. Monitoring and evaluation of natural enemies	
	8.2. Monitoring and evaluation of natural enemies (cont....)	
<b>Week 9</b>	<b>MIDTERM EXAM</b>	
<b>Week 10</b>	<b>Unit-IX</b> 9.1. Rearing techniques of bio-control agents	
	9.2. Role of biological control in IPM	
<b>Week 11</b>	<b>Unit-X</b> 10.1. Commercialization of bio-control agents	
	10.2. Quality management in biological control agents rearing	
<b>Week 12</b>	<b>Unit-XI</b> 11.1. Integration of biological control in pest management	
	11.2. Laws affecting biological control in Pakistan	
<b>Week 13</b>	<b>Unit-XII</b> 12.1. Registration of microbial pesticides	
	12.2. Endophytes as biological control agents	
<b>Week 14</b>	<b>Unit-XIII</b> 13.1. Tritrophic interactions and biological control	
	13.2. Habitat manipulation and natural biological control	
<b>Week 15</b>	<b>Unit-XIV</b> 14.1. Importance of beneficial insects	
	14.2. Role of beneficial insect in Agriculture	
<b>Week 16</b>	<b>Unit-XV</b>	

	15.1. Insect as food	
	15.2. Role of biological control in IPM	
<b>Course Content (Practical)</b>		<b>Assignments/Readings</b>
<b>Week 1</b>	Collection, preservation and identification of predators & parasitoids	
<b>Week 2</b>	Collection, preservation and identification of predators & parasitoids	
<b>Week 3</b>	Collection, preservation and identification of predators & parasitoids	
<b>Week 4</b>	Collection, preservation and identification of predators & parasitoids	
<b>Week 5</b>	Laboratory rearing and culturing of important natural enemies	
<b>Week 6</b>	Laboratory rearing and culturing of important natural enemies	
<b>Week 7</b>	Laboratory rearing and culturing of important natural enemies	
<b>Week 8</b>	Laboratory rearing and culturing of important natural enemies	
<b>Week 9</b>	<b>MIDTERM EXAM</b>	
<b>Week 10</b>	Isolation of entomopathogen from soil	
<b>Week 11</b>	Isolation of entomopathogen from different insect pest	
<b>Week 12</b>	Mass culturing of entomopathogen	
<b>Week 13</b>	Harvesting of entomopathogen	
<b>Week 14</b>	Study of extent of parasitism/predation of different bio-control agents	
<b>Week 15</b>	Storage, shipping and field release methods of natural enemies	
<b>Week 16</b>	Visit to public/ private bio-control labs	
<b>Textbooks and Reading Material</b>		
<ol style="list-style-type: none"> <li>1. Barbosa, P. 1998. Conservation Biological Control. Academic Press.</li> <li>2. Bellows, T.S. Fisher, T.W. Caltagirone, L.E. Dahlsten, D.L. Huffaker, C. and Gardh, G. 1999. Handbook of Biological Control: Principles and Applications of Biological Control. Academic Press, USA.</li> <li>3. Copping, L.G. 2004. The Manual of Biocontrol Agents. BCPC</li> <li>4. De Bach, P. and Rosen, D. 1991. Biological Control by Natural Enemies. CUP Archive.</li> </ol>		

5. Hajek, A. 2003. Natural Enemies: An Introduction to Biological Control. Cambridge University Press
6. Hawkins, B.A. and Cornell, H.V. 1999. Theoretical Approaches to Biological Control. Cambridge University Press
7. Heikki, M.T. Hokkeanen, J. Lynch, M. 1996. Biological Control: Benefits and Risks. Cambridge University Press.
8. Irshad, M. 2008. Biological Control of Insects and Weeds in Pakistan. Higher Education Commission, Islamabad, Pakistan.
9. Rechcigl, J.E. and Rechcigl, N.A. 1999. Biological and Biotechnological Control of Insect Pests. CRC Press September
10. Van Driesche, R.G. and Bellows, T.S. 1996. Biological Control. An International Publishing Company, New York.

**Note:**

1. It is preferable to use latest available editions of books. Mention the publisher & year of publication.
2. The References/ bibliography may be in accordance with the typing manual of the concerned faculty/subject. Preferably follow APA 7<sup>th</sup> Edition publication manual.

**Teaching Learning Strategies**

1. Multimedia
2. White Board
3. Group discussion
4. Quiz/Assignments
5. Demonstration/Activity

**Assignments: Types and Number with Calendar**

**Assessment**

Sr. No.	Elements	Weightage	Details
1.	Midterm Assessment	35%	Written Assessment at the mid-point of the semester.
2.	Formative Assessment	25%	Continuous assessment includes: Classroom participation, assignments, presentations, viva voce, attitude and behavior, hands-on-activities, short tests, projects, practical, reflections, readings, quizzes etc.

3.	Final Assessment	40%	Written Examination at the end of the semester. It is mostly in the form of a test, but owing to the nature of the course the teacher may assess their students based on term paper, research proposal development, field work and report writing etc.
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