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

Programme	B.Sc. (Hons) Agriculture (Major: Entomology)	Course Code	ENT-302	Credit Hours	3 (2-1)
Course Title	**INSECT PHYSIOLOGY**				

Course Introduction

This course is an in-depth examination of the principal physiological and biochemical functions of insects. The course covers the history of the field of insect physiology, as well as the current status, and future directions. Connections will be made between insect physiology ("how insects work") and insect genomics, insect ecology, integrated pest management, etc.

Learning Outcomes

On the completion of the course, the students will:

1. Master an understanding of how insects function.
2. Become familiar with the past, present, and future of insect physiological research.
3. Understand how insect physiology relates to other fields of entomology, as well as to human society.
4. Discuss the relationship between biochemical processes and anatomical structures involved in allowing insects to complete various physiological processes.
5. Illustrate how various biochemical, molecular, and physiological systems are interdependent.
6. Evaluate seminal experiments conducted by the major players in the field of insect physiology and how their work contributed to our current understanding of insect function, while also gaining an appreciation for how a lack of diversity and inclusivity might have hampered the field.
7. Analyze, interpret, critique, and synthesize classical and recent primary literature on insect physiology.
8. Compare and contrast the physiological systems among insects with diverse life histories.
9. Develop conclusions on to what extent insects are good model systems for studying broader biological fields and why.
10. Analyze the interchange between insect species' physiology and its evolution, ecology, and behavior.
11. Predict which aspects of insect physiology can be used for insect control purposes.
12. Be inspired by insect physiological systems to design new technologies, materials, and structures.

Course Content (Theory)		Assignments/Readings
Week 1	**Unit 1** 1. Course Syllabus 1.1. Introduction to Insect Physiology 1.2. Homeostasis	

	1.3. The major internal organ systems of insects	
Week 2	**Unit 2** 2.1. Embryonic development in insects	Reading for Quiz #1: It's not a Bug, It's a Feature: Functional Materials in Insects. Schroeder et al. Adv. Mat. V 30, 2018 (PDF link)
	2.2. Post-embryonic development in insects	
Week 3	**Unit 3** 3. Insect Integument 3.1.1. Structure and function 3.1.2. Modification	
	3.2. Cuticle Chemistry 3.2.1. Composition	
Week 4	**Unit 4** 4.1. Cuticle Chemistry (Continued) 4.2. Molting	Quiz #1 via LMS, complete before noon.
	4.3. Mechanism of moulting	
Week 5	**Unit 5** 5.1. History of Insect Endocrine System	
	5.2. Endocrine System – History (Continued)	
Week 6	**Unit 6** 6.1. Ecdysteroid Hormones 6.1.1. PTTH	Reading for Quiz #2: Developmental Mechanisms of Body Size and Wing-Body Scaling in Insects. Nijhout & Callier. Ann. Rev. Entomology. V 60, 2015 (PDF link)
	6.2. Peptide Hormones	
Week 7	**Unit 7** 7.1. Endocrine System – Juvenile Hormone	Submit Exam Question on Assigned Topic (Round A), complete before midnight.
	7.2. Signal Transduction	
Week 8	**Unit 8** 8.1. Endocrine System – Other Biochemical Messengers	
	8.2. Embryogenesis	
Week 9	**Midterm Exam**	
Week 10	**Unit 9** 9.1. Reproductive System-Introduction	Reading for Quiz #3: Regulatory Pathways Controlling Female Insect Reproduction. Roy et al. Ann. Rev. Entomology V 63, 2018 (PDF link)
	9.2. Reproductive Physiology	

Week 11	**Unit 10** 10.1. Reproductive System –Production	Quiz #3 via LMS, complete before midnight
	10.2. Types of reproduction in insects	
Week 12	**Unit 11** 11.1. Digestive System – Introduction	
	11.2. Nutrition	
Week 13	**Unit 12** 12.1.Circulatory System	Submit Exam Question on Assigned Topic via LMS (Round B), complete before midnight
	12.2. Haemolymph and Haemocytes	
Week 14	**Unit 13** 13.1. Respiratory System of insects 13.2. Adaptations	Reading for Quiz #4: Functional Hypoxia in Insects: Definition, Assessment, and Consequences for Physiology, Ecology, and Evolution. Harrison et al. Ann. Rev. Entomology V 63, 2018 (PDF link)
	13.3. Excretory System	
Week 15	**Unit 14** 14.1. Nervous System - Brain and Ganglia	Quiz #4 via LMS, complete before midnight
	14.2. Vision 14.3. Mechanoreception 14.4. Olfaction/Chemical Ecology	
Week 16	**Unit 15** 15.1. Sound and light production, thermoregulation 15.2. Flight Metabolism	
	15.3. Thermoregulation 15.4. Photoperiodism 15.5. Diapause, Dormancy, and Migration 15.6. Adaptation to Extreme Environments	
Course Content (Practical)		**Assignments/Readings**
Week 1	**Unit 1** 1.1.Physiology of digestion	
Week 2	**Unit 2** 2.1. Physiology of tracheal system	Practical notebook completion
Week 3	**Unit 3** 3.1. Physiology of circulation	

Week 4	**Unit 4** 4.1. Physiology of excretion	Reading for Quiz #5: Central Pattern Generating Networks in Insect Locomotion. Mantziaris et al. Dev. Neurobiology. V 80, 2020 (PDF link)
Week 5	**Unit 5** 5.1. Physiology of reproduction	
Week 6	**Unit 6** 6.1. Physiology of musculature and sensation	
Week 7	**Unit 7** 7.1. Physiology of hormones	Quiz #5 via LMS, complete before midnight
Week 8	**Unit 8** 8.1. Physiology of pheromones	
Week 9	**Midterm Exam**	
Week 10	**Unit 9** 9.1. Developmental systems. 9.1.1. Insect eggs & oogenesis 9.1.2. Embryology	
Week 11	**Unit 10** 10.1. Muscular system 10.1.1. Insect muscle tissue 10.1.2. Types (tubular, close-packed, fibrillar)	Reading for Quiz #1: The Insect Circulatory System; Structure, Function, and Evolution. Hillyer & Pass. Ann. Rev. Entomology V 65, 2020 (PDF link)
Week 12	**Unit 11** 11.1. Muscular system (Cont.) 11.1.2. Muscle contraction 11.1.3. Flight	Practical notebook completion
Week 13	**Unit 12** 12.1. Muscular system (Cont.) 12.1.1. Synchronous vs. asynchronous 12.1.2. Metabolism strategies	Quiz #1 via LMS, complete before midnight
Week 14	**Unit 13**	Practical notebook completion
Week 15	**Unit 14**	Practical notebook completion
Week 16	**Unit 15**	

Textbooks and Reading Material

1. Ashfaq, A. and Sohail, A. 2002. Manual of Insect Physiology. Pakistan Science Foundation.
2. Chapman, R.F. 1998. The Insects: Structure and Function. 4th Ed. Hodder and Stoughton Educational Ltd., U.K.
3. Klowden, M.J. 2002. Physiological Systems in Insects. Academic Press.
4. Litwack, G. 2005. Insect Hormones (Vitamins and Hormones). Elsevier Academic Press, California.
5. Liu, N. 2008. Recent Advances in Insect Physiology, Toxicology and Molecular Biology. Research Signpost Publishers.
6. Patanaik, B.D. 2002. Physiology of Insects. Dominant Publishers and Distributors, Dehli, India.
7. Wigglesworth, V.B. 1972. Principles of Insect Physiology. 7th Ed. Meltron & Co. Ltd. U.K.
8. Yadave, M. 2003. Physiology of Insects. Discovery Publishing House, New Delhi

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 7th 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.