TABLE: COURSE DESCRIPTION

1. GENERAL INFORMATION			
1.1. Course teacher	Darija Lemić	1.6. Year of the study programme	1
1.2. Name of the course	Advanced research methods in entomological science	1.7. Credits (ECTS)	6
1.3. Associate teachers	Ivana Pajač Živković Renata Bažok Katarina M Mikac	1.8. Type of instruction (number of hours L + S + E + e-learning)	10+10+4+6
1.4. Study programme (undergraduate, graduate, integrated)	Postgraduate doctoral study	1.9. Expected enrolment in the course	3
1.5. Status of the course	elective	1.10. Level of application of e-learning (level 1, 2, 3), percentage of online instruction (max. 20%)	3, 20%
2. COURSE DESCRIPTION			
2.1. Course objectives	The main aim of the module is to introduce students with new knowledge and methods used in entomological research, and to enable them to independently research and create new findings in the field of entomology.		

2.2. Course enrolment requirements and entry competences required for the course	Basic understanding of plant pests and their morphology, anathomy and physiology. Basic knowledge on insect genetics and IT technology.
2.3. Learning outcomes at the level of the programme to which the course contributes	-
2.4. Learning outcomes expected at the level of the course (4 to 10 learning outcomes)	1. Analyze and evaluate the efficiency of new methods in entomological research compared to classical methods. 2. Choose and apply adequate methods for estimating the insect populations abundance. 3. Plan and conduct scinetific research using appropriate molecular and morphological methods. 4. Select an appropriate IT technique and use it for analyzing and interpretation of the genetic or biological research results. 5. To create a indenpenent scientific survey, using new methods of monitoring, researching and analyzing data.
2.5. Course content broken down in detail by weekly class schedule (syllabus)	**Previous knowledge about methodology in entomological research**. - Analysis and comparison of classical monitoring methods (visual baits, pheromone baits, photo eclecters etc.) in entomological research and evaluation of their performance in timely pest detection and determination of the moment of suppression. (DL) **New methods of tracking and suppressing insects** ("smart baits", IPM on a wide area, unmanned vehicles) – Introducing to the new insect population monitoring methods and assessing their effectiveness. Insect pests control in a wide area: importance, efficiency assessment, problems in practice. Use of unmanned air vehicles in Entomological Investigations. Evaluation and Comparison with Classic monitoring techniques. (RB, KM) **Molecular techniques in entomological research**. - Use of genetic methods in research of genome changes in insects. Use of PCR analysis in the identification of pests. Introduction of SNP technology into standard entomological research. Detection of gene/enzyme mutations as markers for biological changes (resistance, etc.). (IPZ) **The method of geometric-morphometric in entomology**. - The focus of geometric-morphometric methods is on the phenotype of insects, which is the result of interaction between the genes and the environment, in terms of metric characteristics and their variations in the population. (DL) **Bioinformatics** - Use of data mining (machine learning) for quick interpretation of biological / genetic data. (KM)

Hours	Title of the course unit	Format of instruction (symbol 2.6.)	Teacher/s	Description of teaching units (max. 200 characters)	Connection with learning outcomes (2.4.)

2.6. Format of instruction (mark with X)::	x	lectures (L)	x	independent assignments (I)	2.7. Comments:
	x	seminars and workshops (S)	x	multimedia and the internet (M)	
	x	exercises (E)		laboratory (Lab)	
		on line in entirety (e-L)		work with mentor (W)	
	x	partial e-learning (Pe-L)		(other)	
		field work (F)		(other)	

2.8. Student responsibilities	Attending classes, preparing seminars and materials for workshops and actively participating in seminars and workshops.

2.9. Screening student work (name the proportion of ECTS credits for each activity so that the total number of ECTS credits is equal to the ECTS value of the course)	0,5	Class attendance	2	Research		Practical training
		Experimental work		Report		(other)
		Essay	0,5	Seminar essay		(other)
		Tests	2	Oral exam		(other)
	1	Written exam		Project		(other)

2.10. Grading and evaluating student work in class and at the final exam	During the course, the student's work is evaluated by his active participation in teaching and by the presentation of the seminar work. Independent research conducted under the guidance of a teachers on the subject, and a written report on the research results. The final part of the examination evaluates the acquired knowledge and the students' ability to critically examine, analyze and propose solutions of a given problem and to propose a methodology of research in the field of entomology using newly acquired knowledge.

2.11. Required literature (available in the library and via other media)	**Title**	**Number of copies in the library**	**Availability via other media**
	Insect Molecular Genetics. An introduction to Principles and Applications. Academic Press.	1	da
	Morphometric Tools for Landmark Data: Geometry and Biology. Cambridge University Press.	0	da

	Geometric Morphometrics for Biologists: A Primer. Academic Press; 2 edition	1	da
	Unmanned Aerial Vehicle Systems in Crop Production: A Compendium. Apple Academic Press.	0	da
	Area-Wide Control of Insect Pests From Research to Field Implementation. Springer.	1	da
2.12. Optional literature (at the time of submission of study programme proposal)	1. Use of an enmanned areial vehicle (drone) to survey Nile crocodile populations: A case study at Lake Nyamithi, Ndumo game reserve, South Africa. Biological Conservation. 2. Precision wildlife monitoring using unmanned aerial vehicles. Scientific Reports. 3. Unmanned Aerial Vehicles (UAVs) and Artificial Intelligence Revolutionizing Wildlife Monitoring and Conservation. Sensors. 4. A „Smart“ trap device for detection of crawling insects and other Arthropods in Urban Environments. Electronics. 5. Ecological morphology of the sugar beet weevil Croatian populations: Evaluating the role of environmental conditions on body shape. Zoologischer Anzeiger. 6. Monitoring techniques of the western corn rootworm are the precursor to effective IPM strategies. Pest Management Science. 7. The Temporal and Spatial Invasion Genetics of the Western Corn Rootworm (Coleoptera: Chrysomelidae) in Southern Europe. PLoS ONE 8. Evolutionary Directional Asymmetry and Shape Variation in Diabrotica v. virgifera (Coleoptera: Chrysomelidae): an example using hind wings. 9. Population dynamics of noctuid moths and damage forecasting in sugar beet. Agricultural and Forest Entomology. 10. Area-wide mass trapping by pheromone-based attractants for the control of sugar beet weevil (Bothynoderes punctiventris Germar, Coleoptera: Curculionidae). Pest management science.		
2.13. Quality assurance methods that ensure the acquisition of exit competences	Quality assessment will be checked as it is commonly performed for all modules at the University of Zagreb – through anonymous student questionnaire at the end of the semester. Module delivery success rate will be monitored by the Board for International relations of the Uni ZG Faculty of Agriculture.		
2.14. Other (as the proposer wishes to add)			