

**Study program:** Geoinformation Technologies

**Qualification:** PhD

<b>General Information</b>			
<b>University</b>	Armenian National Agrarian University (ANAU)		
<b>Course title</b>	<b>UAV technologies</b>		
<b>The responsible lecturer</b>	Associate Professor Naira Aloyan Assistant Professor Tigran Hovhannisyan Email: <a href="mailto:nairaloyan@gmail.com">nairaloyan@gmail.com</a> , <a href="mailto:aloyannaira@yahoo.com">aloyannaira@yahoo.com</a> <a href="mailto:tigranhov20@gmail.com">tigranhov20@gmail.com</a>		
<b>Course type</b>	Elective		
<b>Course Goal</b>	The goal of the course is to promote the development of precision agriculture in Armenia, the introduction of innovative technologies in the field of agriculture, and to train appropriate specialists to fill new jobs.		
<b>Prerequisites and co-requisites (if applicable):</b>	To study the subject, as a prerequisite, it is necessary to have certain knowledge and skills in advanced surveying, cartography, aerial photography, mathematics and programming.		
<b>Type (compulsory/ optional):</b>	Elective		
<b>Duration and ECTS Credits</b>	<b>In credits (ECTS)</b>	<b>In hours</b>	<b>Semester</b>
	5	150 (84 auditorium + 66 individual)	Spring
<b>Learning Outcomes</b>	After completing this course, the students should be able to: 1. to ensure uninterrupted operation of UAVs, 2. to carry out mapping using UAVs, 3. calculate vegetation indicators, 4. carry out spraying using UAV.		

<b>Syllabus (List of lessons)</b>	<b>Module 1</b>	<b>Information about programs and applications that support UAV work</b>
		<ul style="list-style-type: none"> <li>• Existing programs</li> <li>• Application in precision agriculture</li> </ul>
	<b>Module 2</b>	<b>Use of UAVs for mapping purposes</b>
		<ul style="list-style-type: none"> <li>• A detailed study of the Phantom 4 multispectral UAV</li> <li>• Field data processing, orthophoto map acquisition Drones</li> </ul>
	<b>Assignment #1</b>	Demonstrate the basic principles of using the Phantom 4 multispectral UAV with practical work and test the processing of the results of field measurements
	<b>Module 3</b>	<b>High-precision positioning devices (GNSS, GPS, ArmREF 02), methods ensuring the accuracy of mapping (RTK, PPK)</b>
		<ul style="list-style-type: none"> <li>• What is GNSS and how does it work.</li> <li>• GPS system and application areas</li> <li>• The procedure and results of the creation of the ArmREF 02 national geodetic network with GPS satellite technologies in the territory of the Republic of Armenia</li> <li>• The methods and ways of collecting the coordinates of plan and elevation geodetic grid points. Single Base RTK, Network RTK</li> </ul>
	<b>Assignment #2</b>	To present the working principle of GNSS, GPS systems, areas of application, procedure and results of creation of ArmREF 02 national geodetic network
	<b>Module 4</b>	<b>Spectrum of electromagnetic radiation, calculation of vegetation indicators NDVI</b>
		<ul style="list-style-type: none"> <li>• Electromagnetic spectrum, spectral reflectance, spatial resolution, data acquisition, interpretation.</li> <li>• Aerial photography and its application in agriculture</li> <li>• Classification and application of satellite images in the GIS</li> <li>• NDVI index calculation</li> </ul>

	<b>Assignment #3</b>	Describe the elements of the electromagnetic spectrum, the components of remote sensing, the data acquisition, input, and analysis system. To present the nature and types of spectral reflection. Show the procedure for calculating the NDVI indicator.
	<b>Module 5</b>	<b>Study of Agras T20 ATS, implementation of spraying</b>
		<ul style="list-style-type: none"> <li>• Structure, working principle, software and operational requirements of Agras T20 ATS.</li> <li>• Demonstration of the working skills of Agras T20 ATS with the help of simulation software.</li> </ul>
	<b>Assignment #4</b>	To introduce the structure, working principle and simulation driving skill of Agras T20 ATS.
<b>Short description</b>	The course on mapping and spraying using UAVs is aimed at imparting to the participants the necessary knowledge and skills needed to organize this process. During the course, the participants will get acquainted with the features of using multispectral UAV, which implies obtaining accurate maps and calculating vegetation indicators, which in turn is designed to assess the condition of agricultural crops in detail before spraying and makes it possible to make spraying more targeted. Comprehensive knowledge of the field will help participants make spraying more efficient and increase the level of application of innovative technologies in the field of agriculture.	
<b>Recommended textbooks and links (in order of relevance):</b>	Required text and materials 1 <u>Udit Debangshi</u> , Drone -Applications in Agriculture, Chronicle of Bioresource Management 2021, 5(3):115-12 <a href="https://www.researchgate.net/publication/334778584">https://www.researchgate.net/publication/334778584</a> <u>Unmanned Aerial Vehicles in Agriculture A Review of Perspective of Platform Control and Applications</u> 2. Dr. Sharad Pachpute, Working Principle and Components of Drone <a href="https://cfdflowengineering.com/working-principle-and-components-of-drone/#:~:text=High%20fluid%20pressure%20at%20the,of%20the%20aerofoil%20or%20propeller.">https://cfdflowengineering.com/working-principle-and-components-of-drone/#:~:text=High%20fluid%20pressure%20at%20the,of%20the%20aerofoil%20or%20propeller.</a>	

	<p>3. <u>Gabriel Hugh Elkaim, Fidelis Adhika Pradipta Lie, Demoz Gebre-Egziabher, Principles of Guidance, Navigation, and Control of UAVs, Handbook of Unmanned Aerial Vehicles (pp.347-380)</u></p> <p><a href="https://link.springer.com/referenceworkentry/10.1007/978-90-481-9707-1_56">https://link.springer.com/referenceworkentry/10.1007/978-90-481-9707-1_56</a></p> <p>4. <u>Jeongeun Kim, Seungwon Kim, Chanyoung Ju, Hyoung Il Son, Unmanned Aerial Vehicles in Agriculture: A Review of Perspective of Platform, Control, and Applications, IEEE Access PP(99):1-1</u></p> <p><a href="https://www.researchgate.net/publication/334778584_Unmanned_Aerial_Vehicles_in_Agriculture_A_Review_of_Perspective_of_Platform_Control_and_Applications">https://www.researchgate.net/publication/334778584_Unmanned_Aerial_Vehicles_in_Agriculture_A_Review_of_Perspective_of_Platform_Control_and_Applications</a></p>
<p><b>Assessment methods and criteria</b></p>	<p>Final exam with 20-point grade.</p> <p>To successfully complete this course, students must achieve a passing grade of 40% or higher on the overall course and 50% or higher on the mandatory final project. Under final project students should develop a research proposal.</p>