Study program: Geoinformation Technologies

Qualification: PhD

General Information	
University	Armenian National Agrarian University (ANAU)
Course title	**UAV technologies**
The responsible lecturer	Associate Professor　　Naira Aloyan nairaloyan@gmail.com, aloyannaira@yahoo.com Assistant Professor　　Tigran Hovhannisyan tigranhov20@gmail.com
Course type	Elective
Course Goal	The goal of the course is to promote the development of precision agriculture in Armenia, introduce innovative technologies in the field of agriculture, and train appropriate specialists to fill new jobs.
Prerequisites and co-requisites (if applicable):	In order to study the subject, as a prerequisite, it is necessary to have certain knowledge and skills in geodesy, cartography.
Type (compulsory/ optional):	Elective

Duration and ECTS Credits	**In credits (ECTS)**	**In hours**	**Semester**
	5	150 (40 auditorium + 110 individual)	Fall

Learning Outcomes	After completing this course, the students should be able to: 1. Be able to operate the Multispectral Camera Drone 2. To carry out topographical survey using drones, 3. Calculate the NDVI indexes 4. Process the data obtained by the drone with a suitable computer program 5. Analysis of the results of the study carried out with a drone

	Module 1	**Information about programs and applications that support UAV work** To be able to master the computer software applications for processing the results of the research works carried out by drones
		• Existing programs • Application in precision agriculture
	Module 2	**Use of UAVs for mapping purposes**
		• A detailed study of Phantom 4 multispectral UAV • Operation of the Phantom 4 Multispectral UAV • Field data processing, orthophoto map acquisition Drones
	Assignment #1	Demonstrate the basics of using the Phantom 4 multispectral drone through hands-on work and compare drone footage with field measurement
Syllabus (List of lessons)	**Module 3**	**High-precision positioning devices (GNSS, GPS, ArmREF 02), methods ensuring the accuracy of mapping (RTK, PPK)**
		• What is GNSS and how does it work. • GPS system and application areas • 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 • The methods and ways of collecting the coordinates of plan and elevation geodetic grid points. Single Base RTK, Network RTK
	Assignment #2	To present the working principle of GNSS, GPS systems, areas of application, procedure and results of creation of ArmREF 02 national geodetic network
	Module 4	**Spectrum of electromagnetic radiation, calculation of vegetation indicators NDVI**
		• Electromagnetic spectrum, spectral reflectance, spatial resolution, data acquisition, interpretation. • Aerial photography and its application in agriculture

		• Classification and application of satellite images in the GIS • NDVI index calculation
	Assignment #3	Show the procedure for calculating the NDVI indicator.
	Module 5	**Study of Agras T20 ATS, implementation of spraying**
		• Structure, working principle, software and operational requirements of Agras T20 ATS. • Demonstration of the working skills of Agras T20 ATS with the help of simulation software.
	Assignment #4	To introduce the structure, working principle and simulation driving skill of Agras T20 ATS.
Short description	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.	
Recommended textbooks and links (in order of relevance):	Required text and materials 1 Udit Debangshi, Drone -Applications in Agriculture, Chronicle of Bioresource Management 2021, 5(3):115-12 https://www.researchgate.net/publication/334778584_Unmanned_Aerial_Vehicles_in_Agriculture_A_Review_of_Perspective_of_Platform_Control_and_Applications 2. Dr. Sharad Pachpute, Working Principle and Components of Drone https://cfdflowengineering.com/working-principle-and-components-of-drone/#:~:text=High%20fluid%20pressure%20at%20the,of%20the%20aerofoil%20or%20propeller.	

	3. 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) https://link.springer.com/referenceworkentry/10.1007/978-90-481-9707-1_56 4. 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 https://www.researchgate.net/publication/334778584_Unmanned_Aerial_Vehicles_in_Agriculture_A_Review_of_Perspective_of_Platform_Control_and_Applications
Assessment methods and criteria	Final exam with 20-point grade. 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 (individual work). Under final project students should develop a research proposal. **Evaluation factors (%) and their actual score on a 100-point scale** | №	**Factor:**	**%**
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1	Attendance	15
2	Individual work	40
3	Final exam	45	

Course evaluation scale according to the ECTS evaluation system

Evaluation	Accumulated points (%)	ECTS/ATC Grade	20 point scale	ANAU Grade
Pass	90-100	A	18-20	5
	80-89	B	16-17	4
	70-79	C	14-15	4
	60-69	D	11-13	3
	50-59	E	8-10	3
Fail	0-49	F/FX*	0-7	2