

Government of Pakistan

National Vocational and Technical Training Commission

Prime Minister's Hunarmand Pakistan Program

"Skills for All"



Course Contents / Lesson Plan

Course Title: Drone Applications in Agriculture

Duration: 3 Months

Revised Edition

Trainer Name	
Course Title	Drone Applications in Agriculture
Objectives and Expectations	<p>Employable skills and hands on practice on Drone Technologies in Agriculture</p> <p>The purpose of this course is to provide students with the comprehensive information and practical skills necessary for proficient exploitation of drone technology in agricultural practices, with a particular emphasis on improving efficiency, precision, and sustainability in crop protection, crop health monitoring and analysis.</p> <p>Objectives of the Course:</p> <ol style="list-style-type: none"> 1. Understanding the Agricultural Needs and Drone Fundamentals <ul style="list-style-type: none"> • To identify challenges in modern agriculture. • Students will be to explore how drones address agricultural challenges efficiently. • Participants will gain a comprehensive understanding of drone components and functionalities and drone assembling. • Students will be able to learn about different types of drones used in agricultural fields. • Learn regulations and safety protocols for drone use. 2. Agricultural Mapping and Data Processing <ul style="list-style-type: none"> • Individuals will learn about drone-based mapping techniques for agricultural fields. • Trainees will be able to understand data acquisition methods and relevant payloads. • Participants will gain hands-on experience in processing drone-collected data. • Students will utilize the different softwares and tools for data interpretation and analysis. 3. Crop Monitoring and Health Assessment: <ul style="list-style-type: none"> • Individuals will learn advanced methods for using drones to monitor crop health. • Students will also learn to identify stress factors, diseases, and pests using aerial data. 4. Precision Spraying and Treatment: <ul style="list-style-type: none"> • Participants will gain insights into drone-enabled precision spraying techniques for targeted pesticide or treatment application. • Student will Learn about the equipment and methods used for precise and efficient treatment delivery. <p>Expectations of the Course:</p> <p>In this three-month course on Drone Applications in Agriculture trainees will get a comprehensive understanding of the operation of drones and the various types of drones that are utilized in an agricultural environment. Trainees will learn about the different components of drones and their functionalities, and they will also be able to assemble and dismantle spraying system and part of drones. Trainees will gain an understanding of how these Unmanned Aerial Vehicles (UAVs) generate maps of farms and collect vital information from fields and how this information/data can be used to identify the biotic and abiotic stresses.</p> <p>Throughout the course, Instructor will place a strong emphasis on the importance of safety and adhering to rules when operating drones in agricultural settings. Participants will discover how drones are already making a difference for farmers through real-life examples from different parts of the world. Throughout the course, trainees will have numerous opportunities to put their knowledge into practice by tackling real-world farming challenges with the help of drones. Additionally, participants will be encouraged to collaborate with their peers, fostering an environment where ideas can be shared, and projects can be worked on collectively. This collaborative approach will enhance the learning experience for everyone involved.</p> <p>By the end of the course, participants will have acquired hands-on experience in utilizing drones for agricultural purposes and trainees can showcase their skills in effectively communicating the advantages of drone technology in farming. This course goes beyond mere comprehension of drones. It focuses on the practical application of drones in crop protection, crop health</p>

	monitoring and effectively conveying drone significance to others.
Entry-level of trainees	Intermediate
Learning Outcomes of the course	<p>By the end of this course, students will be able to:</p> <ul style="list-style-type: none"> • Expertly operate drones/UAVs with proper precautionary measures. • Assemble and dismantle spraying systems and payloads of drones. • Efficiently apply agro-chemical using drone technology • Use drones for crop health monitoring and assessment. • Interpret and analyze drone-gathered data to identify crop health, stress factors, and agricultural issues. • Apply precision agriculture strategies utilizing drones for optimized resource management and targeted interventions. • Effectively communicate insights derived from drone data to stakeholders within the agricultural domain. • Develop practical solutions for agricultural challenges using drone technology.
Course Execution Plan	<p>The total duration of the course: 3 months (12 Weeks) Class hours: 4 hours per day Theory: 20% Practical: 80% Weekly hours: 20 hours per week Total contact hours: 240 hours</p>
Companies offering jobs in the respective trade	<ol style="list-style-type: none"> 1- Multinationals Pesticide Companies e.g. Syngenta, Buyer, FMC, Evyol Group 2- Multinationals Agricultural Firms Drone Ag Solutions A&Z Agro Industries (Pvt) Ltd. AgriDunya Technologies. BaKhabar Kissan (BKK) Barket Fertilizers. Bount Cattle & Agri Farm. Engro Corp. Engro Fertilizers Limited. FERTISCIENCE. FFBL Careers. Faran Sugar Mills Limited. Fauji Fertilizer Company Limited. 3- Entrepreneurship & Startups
Job Opportunities	<ul style="list-style-type: none"> • Drone Pilot/Operator • Precision Farming Consultant • Drone Program Co-Ordinator • Crop Reporting Associate • Consultant
No of Students	25
Learning Place	Classroom / Lab/ Field
Instructional Resources	<ul style="list-style-type: none"> • Handbook of Research on AI-Equipped IoT Applications in High-Tech Agriculture. (2023). United States: IGI Global. Unmanned Aerial Vehicle in Modern Agriculture • Zaman, Q. (Ed.). (2023). Precision Agriculture: Evolution, Insights and Emerging

Trends. Netherlands: Elsevier

Precision Agriculture: Evolution, Insights and Emerging Trends

- Applying Drone Technologies and Robotics for Agricultural Sustainability. (2023). United States: IGI Global.

Use of Drone Technology in Agriculture

- Krishna, K. R. Agricultural Drones. (2021): Apple Academic Press, Incorporated.

Agricultural Drones

- https://cgspace.cgiar.org/bitstream/handle/10568/89779/ICT082E_PDF.pdf

Drone for Agriculture

- <https://www.ijcmas.com/9-6-2020/R.%20B.%20Kalamkar,%20et%20al.pdf>

Drone and its Applications in Agriculture

- https://www.youtube.com/watch?v=fe_enhIXcf8

First Flight and Practicing with the Agras

- <https://www.youtube.com/watch?v=TtjR0VhTKXQ>

The Safety Application of Agricultural Drone

- <https://www.youtube.com/watch?v=Cjmt3XOy160>

Different DJI Drones for Mapping/Surveying - Beginner

MODULES

Weeks	Module Title	Day	Hour	Learning Units	Tasks			
Week 1	Introduction to Agriculture	1	1	What is Agriculture?	Task 1-4			
			2	Overview of Agriculture: History, significance, and its role in society.				
			3	Domains of Agriculture: Horticulture, Agronomy, Entomology etc.				
			4	Agricultural Systems: Exploring different farming systems (intensive, extensive, mixed).				
		2	1	Crop Types: Grains, vegetables, fruits, legumes, etc.				
			2	Soil Management: Soil types, composition, erosion control, and fertility				
			3	Crop Protection: Pest management, diseases, and organic methods.				
			4					
		3	1	Crop Production Technologies of Major Crops				
			2					
			3					
			4					
		4	1	Field Preparations and Tillage Practices				
			2	Conventional Farming				
			3,4	Modern Farming				
		5	1-4	Discussion and Task Evaluation				
			Basic Electronics	1		1	Introduction to Electronics	
						2	Electronics Materials: Active Components, Passive Components etc.	
						3	Resistors, Capacitor, Inductor, Transistor, diode, Integrated circuits, Transformer, Regulator, Crystal, LEDs, Batteries, Switches and Potentiometer etc.	Task 5
						4		
2	1			Current, Resistance and Ohm's Law, Digital Logic, Polarity, Analogue vs Digital	Task 6			
	2							

Week 2			3	Circuit Designing, Printed Circuit Boards (PCB), Simulation	Task 7		
			4				
		3	1	Introduction to Microcontrollers			
			2	Types of Microcontrollers			
			3	Introduction to Arduino			
			4				
		4	1	Types of Arduino Boards			
			2	Programming Basics			
			3	Arduino Programming Basics	Task 8		
			4	Interfacing Sensors with Arduino	Task 9		
		5	1-4	Discussion and Tasks Evaluation			
		Week 3	Drone Technology	1	1	Introduction to Flight Controllers	
					2		
					3	Types of Flight Controllers: Pixhawk etc.	
					4		
2	1			Main Components of Drone including Accelerometer, Antenna, Altimeter, Battery, Camera (FPV), Electronic Speed Controller, GPS Module, Obstacles avoidance Sensors, Brushless DC motors	Task 10		
	2						
	3						
	4						
3	1			Drone Frame Design and Aerodynamics			
	2						
	3			Propellers and Drone Stability			
	4						
4	1			Drone Flight Safety			

			2	Precautions Before Mission Planning	Task 11	
			3	Types of Drones: Fixed Wings & Multirotor etc.		
			4			
		5	1	DJI Flight Simulator	Task 12	
			2			
			3	Discussions and Task Evaluation		
			4			
Week 4	Flight Operations	1	1	Assembling of Spraying Systems and Payloads of Drones	Task 13	
			2			
			3	Dismantling of Drones	Task 14	
			4			
		2	1	Principle of Radio Frequency and Wireless Communication		
			2			
			3	Principle of Remote Controllers and Radio Telemetry	Task 15	
			4			
		3	1	Components of Sprayer Drones		
			2	Efficient Drone Spraying Strategies and Precautions	Task 16	
			3	Traditional Spraying vs Drone Spraying	Task 17	
			4	Limitation of Drones Sprayers		
		4	1	Sprayer Drones Android Applications: Installation and Execution etc.	Task 18	
			2			
			3			
			4			
	5	1-4	Discussion and Task Evaluation			
	Week 5	Crop Protection and Spraying Techniques	1	1	Introduction to Pesticides	
				2-3	Types of Pesticides: Fungicide & Herbicide etc.	Task 19
				4	Environmental Impact and Concerns	
2			1	Crop Knowledge and their Needs		
			2-3	Regional Crops and their Potential Risks to Pests	Task 20-21	
			4	Identification of Crops		
3			1-4	Spraying Techniques: Distance, Height, and Speed of Drones etc.	Task 22	
4			1-2	Safety and Precautions During Flight and Spraying		
			3	Flushing of Tank & Nozzles of Spraying Systems	Task 23	

			4	Cleaning and Care of Drones	Task 24
		5	1-4	Discussions and Task Evaluation	
Week 6	Midterm				
Week 7	Introduction to Mapping Drones	1	1	What is Drone Mapping?	
			2-3	Types of Aerial Imagery: RGB Imaging & Multispectral Imaging	
			4	Mapping and their Applications in Agriculture	
		2	1	Mapping Drone Selection Process: Specification and Price etc.	
			2		
			3-4	Models of Mapping Drones: DJI Phantom Pro & DJI Matrice M600 etc.	Task 25
		3	1-2	Limitation of Different Models of Mapping Drones	
			3-4	Mounting and Dismounting of Payloads	Task 26
		4	1-2	What is Remote Sensing? Aerial & Satellite Remote Sensing	
			3-4	Software overview: exploring Mapping and Data Analysis Software used in Agricultural Drone Applications.	Task 27
		5	1-2	RTK Based Mission Planning	
	3-4	Discussion and Task Evaluation			
Week 8	Payloads	1	1-3	What are different types of payloads for fixed wing and multirotor drones	
			4	Discussions and tasks evaluation	Task 28
		2	1-3	What are Multispectral sensors?	
			4	Different types of multispectral sensors	
		3	1	What are hyper-spectral sensors?	
			2		
			3	Types of hyperspectral sensors	
			4		Task 29
		4	1	What are thermal sensors?	

			2				
			3	Types of thermal sensors			
			4		Task 30		
		5	1	Lidar Mapping	Task 31		
			2				
			3	Mounting of payloads and communication with drone			
			4		Task 32		
Week 9	Data Acquisition and Processing	1	1-2	Data acquisition applications			
			3-4	Pix 4D for image stitching of drone data	Task 33		
		2	1-2	Installation of Software / Pix 4D			
			3	Introduction to ArcGis			
			4	Installation of software			
		3	1-2	RGB data acquisition			
			3-4	RGB data Processing	Task 34		
		4	1	RGB data Analysis			
			2				
			3	Multispectral data acquisition			
			4				
		5	1-2	Multispectral data Processing	Task 35		
			3-4	Multispectral data Analysis			
		Week 10	Field Deployment Strategies	1	1-4	Planning Mapping Missions for Varied Agricultural Landscapes and Crop Types.	
				2	1-4	Adapting Flight Plans for Seasonal Changes and Different Growth Stages of Crops.	

		3	1-4	Field Visit for Data Acquisition	Task 36
		4	1-4	Prepare a Project to Calculate Particular Indices to Monitor Crop Health: NDVI & SAVI etc.	
		5	1-4	Download Aerial Imagery/Sample Data to Calculate Different Vegetation Indices	
Week 11	Project Planning, Risk Management and Regulatory Compliance	1	1-4	Motivational Lecture of Entrepreneurs	
		2-3	1-4	Field Survey, Project Planning, Cost Estimation, Project Refinement & Project Execution	Task 37
		4	1-2	Legal Framework and Regulations	
			3-4	Emergency Procedures and Risk Management	Task 38
		5	1-2	Closing Remarks	Task 39
			3-4	Motivational lecture: How to make CV? <ul style="list-style-type: none"> • Add Personal Information • Add Educational details • Add Experience/Portfolio • Add contact details/profile 	Task 40

		links	
Week 12	Final Exams Task 41-43		

Annexure-I:

Tasks for Certificate

Task No	Task	Description	Week
1.	Agriculture in Society	Group discussion on the significance of agriculture in society.	Week 1
2.	Crop Identification	Identify and categorize different crop types.	
3.	Farming Techniques Comparison	Debate - Conventional vs. Modern Farming.	
4.	Case Study Presentations	Groups present case studies related to different agricultural topics.	
5.	Use of multi-meter	Use of Multi-meter (Voltage and Current Measurements).	Week 2
6.	Breadboard wiring practice	Make a simple circuit of LED blinking on bread-board.	
7.	Circuit Designing	Make a simple circuit of LED flasher using 555 timer. Proteus Simulation for the above circuit.	
8.	Arduino Programming	Installation of Arduino IDE. LED blinking using Arduino.	
9.	Sensor Interfacing	Use HC-SR 04 sensor to collect distance data using Arduino. Use soil sensor to collect moisture data using Arduino.	
10.	Drones Component Identification	Hands-on identification and assembly of drone components.	Week 3
11.	Pre-mission Planning Exercise	Group discussion and planning exercise for a simulated drone mission.	
12.	DJI Flight Simulator Training	Hands-on experience using the DJI flight simulator for flight training.	
13.	Assembling Spraying Systems	Hands-on session for assembling spraying systems onto drones.	Week 4
14.	Dismantling Practice	Dismantling of drones and their attached spraying systems.	
15.	Remote Controller and Telemetry	Hands-on demonstration of remote controllers and telemetry systems.	
16.	Efficient Spraying Techniques	Practical exercise on efficient spraying strategies using simulation or small-scale spraying.	
17.	Comparison: Traditional vs. Drone Spraying	Group discussion and analysis comparing traditional spraying methods with drone spraying.	
18.	Android Application Installation	Step-by-step guidance on installing and executing sprayer	

		drone applications.	
19.	Pesticide Introduction and Classification	Write name and types of pesticides (fungicides, herbicides, etc.) with examples.	Week 5
20.	Understanding Regional Crops	Field trip or virtual tour to identify and study regional crops.	
21.	Potential Risks to Regional Crops	Group exercise to identify potential pest risks to various regional crops and give some names of already known pests of the regions.	
22.	Practical Spraying Techniques	Hands-on session on drone spraying techniques, focusing on distance, height, and speed adjustments.	
23.	Spraying System Maintenance	Demonstration and practice of flushing tanks and nozzles of spraying systems.	
24.	Drone Cleaning and Care	Workshop on the cleaning and maintenance of drones after spraying operations.	
25.	Drone models identification	Identify and differentiate various drone models and their working.	Week 7
26.	Drone body assembling	Practice on Assembling and disassembling of parts of drone.	
27.	Softwares for data analysis	Practical and overview of different software.	
28.	Payloads mounting practice	Setup Payloads and mounting brackets.	Week 8
29.	Hyperspectral sensor mounting	Wiring and plugs setup of hyperspectral sensor.	
30.	Thermal Sensor mounting	Hands on practice of Thermal mounting brackets.	
31.	LIDAR mount bracket	Hands on practice of LIDAR wiring and adapter connection on drone.	
32.	DJI Sky port mounting	Hands on practice of DJI Sky port Mounting and communication with drone RC.	
33.	Practice on Pix 4-D Software	Installation and practice on drone collected data.	Week 9
34.	RGB data processing	Practice on RGB Data collected.	
35.	Multispectral data processing	Practice on Multispectral data.	
36.	Field Survey and Planning	Field trip to survey a site for implementation of drone technologies.	Week 10
37.	Cost Estimation Exercise	Group activity - estimating costs involved in project execution.	Week 11
38.	Emergency Procedures and Risk Management Workshop	Role-playing scenarios for emergency situations.	
39.	Closing Remarks and Discussions	Final discussions on key takeaways and lessons learned from the course.	
40.	Creating a curriculum	Provide a Step-by-step guide on how to make a CV?	

	Vitae (CV)	<ul style="list-style-type: none"> Internet help materials: https://www.leratongmission.co.za/word-resume-tem/?gad_source=1&gclid=Cj0KCQiAj_CrBhD-ARIsAliMxT9dEE0tWacvXdKzQ2hckmMJix1aVzR5pM-tTl-k3pdOarfk8Sokh8aAlnCEALw_wcB 	
41.	Drone Flying practice Final tests	Use mapping to monitor and analyze the health of crop in a designated field.	Week 12
42.	Drone Flying practice Final tests	Setup the drone and charge the batteries for agriculture spraying, involve specific components and consideration for efficient results	
43.	Sensor Selection	Suitable sensor selection for suitable data collection in the field and calculate indices	

Annexure-II:
Motivational Lectures and resources
Drone Applications in Agriculture

What Is the Role of Good Manners in the Workplace? By Qasim Ali Shah | In Urdu

<https://www.youtube.com/watch?v=Qi6Xn7yKIIQ>

Hisham Sarwar Motivational Story | Pakistani Freelancer

https://www.youtube.com/watch?v=CHm_BH7xAXk

Drone AG Solutions Introduction by CEO Dr. Muhammad Naveed Tahir

<https://www.youtube.com/watch?v=l339dY02xo4>

XAG P100 Pro Agricultural Drone. The Essential Guide to Product Features by XAG Co-founder

<https://www.youtube.com/watch?v=NQInONAwQPg>

Technical help and resource center

<https://c4pa.net/>

MOTIVATIONAL LECTURES LINKS.

<u>TOPIC</u>	<u>SPEAKER</u>	<u>LINK</u>
How to Face Problems In Life	Qasim Ali Shah	https://www.youtube.com/watch?v=OrQte08MI90
Just Control Your Emotions	Qasim Ali Shah	https://www.youtube.com/watch?v=JzFs_yJt-w
How to Communicate Effectively	Qasim Ali Shah	https://www.youtube.com/watch?v=PhHAQEGehKc
Your ATTITUDE is Everything	Tony Robbins Les Brown David Goggins Jocko Willink Wayne Dyer Eckart Tolle	https://www.youtube.com/watch?v=5fS3rj6eIFg
Control Your EMOTIONS	Jim Rohn Les Brown TD Jakes Tony Robbins	https://www.youtube.com/watch?v=chn86sH005U
Defeat Fear, Build Confidence	Shaykh Atif Ahmed	https://www.youtube.com/watch?v=s10dzfbozd4
Wisdom of the Eagle	Learn Kurooji	https://www.youtube.com/watch?v=bEU7V5rJTtw
The Power of ATTITUDE	Titan Man	https://www.youtube.com/watch?v=r8LJ5X2ejqU
STOP WASTING TIME	Arnold Schwarzenegger	https://www.youtube.com/watch?v=kzSBrJmXqdg
Risk of Success	Denzel Washington	https://www.youtube.com/watch?v=tbnzAVRZ9Xc

Annexure-III:

Workplace/Institute Ethics Guide

Work ethic is a standard of conduct and values for job performance. The modern definition of what constitutes good work ethics often varies. Different businesses have different expectations. Work ethic is a belief that hard work and diligence have a moral benefit and an inherent ability, virtue, or value to strengthen character and individual abilities. It is a set of values-centered on the importance of work and manifested by determination or desire to work hard.

The following ten work ethics are defined as essential for student success:

1. Attendance:

Be at work every day possible, plan your absences don't abuse leave time. Be punctual every day.

2. Character:

Honesty is the single most important factor having a direct bearing on the final success of an individual, corporation, or product. Complete assigned tasks correctly and promptly. Look to improve your skills.

3. Team Work:

The ability to get along with others including those you don't necessarily like. The ability to carry your weight and help others who are struggling. Recognize when to speak up with an idea and when to compromise by blend ideas together.

4. Appearance:

Dress for success set your best foot forward, personal hygiene, good manner, remember that the first impression of who you are can last a lifetime

5. Attitude:

Listen to suggestions and be positive, accept responsibility. If you make a mistake, admit it. Values workplace safety rules and precautions for personal and co-worker safety. Avoids unnecessary risks. Willing to learn new processes, systems, and procedures in light of changing responsibilities.

6. Productivity:

Do the work correctly, quality and timelines are prized. Get along with fellows, cooperation is the key to productivity. Help out whenever asked, do extra without being asked. Take pride in your work, do things the best you know-how. Eagerly focuses energy on accomplishing tasks, also referred to as demonstrating ownership. Takes pride in work.

7. Organizational Skills:

Make an effort to improve, learn ways to better yourself. Time management; utilize time and resources to get the most out of both. Take an appropriate approach to social interactions at work. Maintains focus on work responsibilities.

8. Communication:

Written communication, being able to correctly write reports and memos.

Verbal communications, being able to communicate one on one or to a group.

9. Cooperation:

Follow institute rules and regulations, learn and follow expectations. Get along with fellows, cooperation is the key to productivity. Able to welcome and adapt to changing work situations and the application of new or different skills.

10. Respect:

Work hard, work to the best of your ability. Carry out orders, do what's asked the first time. Show respect, accept, and acknowledge an individual's talents and knowledge. Respects diversity in the workplace, including showing due respect for different perspectives, opinions, and suggestions.