

## MODULE 2 – LESSON 1

# Physical Inspection and Diagnostic Tools

## LESSON PLAN

### GENERAL INFORMATION

#### LEARNING ACQUISITIONS

At the end of the lesson, students will be able to:

- Explain appropriate documentation procedures
- Expertise in visual inspection technique
- Explain damage analysis methods
- Perform and absorb pre-flight detail checks
- Indicate component-based common failures, symptoms and definitions

#### TIME

1 lesson hour

#### METHODS AND TECHNIQUES

Direct Instruction & Presentation

Demonstration Method

Video-Based Learning

Hands-on / Experiential Learning

Project-Based Learning (PBL) (work on real-life drone repair projects to integrate theory and practice)

Collaborative Learning

Questioning and Discussion Techniques

Problem-Solving Approach

#### RESOURCES, TOOLS, AND EQUIPMENT

Presentation

Video Tutorials

Handbook for UAV Repair and Maintenance Technicians

UAV Parts

Computer or tablet

## IMPLEMENTATION OF THE LESSON

### INTRODUCTION

#### GAINING ATTENTION AND MOTIVATION

In UAVs, a single overlooked crack, a loose connector, or a misread sensor reading can jeopardize flight safety and mission success. This section highlights the vital importance of physical inspection and diagnostic tools in ensuring UAV airworthiness. By mastering documentation procedures, visual inspection techniques, and damage analysis methods, UAV technicians not only detect faults but also prevent failures before they occur. Understanding component-based symptoms and performing detailed pre-flight checks build both technical confidence and operational excellence. The motivation behind these skills is clear—effective inspection and diagnostics keep UAVs flying safely, efficiently, and with trust in every mission.

### DEVELOPMENT

#### IMPLEMENTATION OF THE LESSON CORE

- Students watch Module 2 Video 1 and review the steps of the record keeping guide (Resource 1)
- Students watch Module 2 Video 2 and review the steps of visual inspection techniques (Resource 2)
- Students watch Module 2 Video 3 and list damage assessment methods (Resource 3)
- Students watch Module 2 Video 4 and prepare a pre-flight checklist (Resource 4)
- Students watch Module 2 Video 5 and identify common failures and indicators for UAV components (Resource 5)
- Hands-on activity through working on UAV parts.

### CONCLUSION

#### SUMMARISING

To conclude the lesson, the trainer will emphasize that UAV safety depends on meticulous attention to detail. They will recap how even minor issues like a small crack, a loose connector, or an unusual sensor reading can compromise a mission. The trainer will highlight the importance of combining physical inspections with diagnostic tools to ensure airworthiness. Key takeaways will include mastering documentation procedures, perform thorough visual and pre-flight checks, and understand component-based symptoms. By applying these skills consistently, UAV technicians can detect and prevent failures, enhancing both operational safety and mission reliability. The trainer will close by reinforcing that disciplined inspection and diagnostics are not just procedures—they are the foundation of confidence, efficiency, and trust in UAV operations.

#### ASSIGNMENT

- What are the types of UAV maintenance record keeping?
- What types of data should be included in a drone's basic identity record?
- Before starting the fuselage inspection, what tools should the UAV maintenance technician prepare

- List the 4 types of UAV damage detection methods.
- What are two common signs of motor malfunction in UAVs.

#### **EVALUATION OR TESTING**

- Trainer evaluates the record keeping guideline steps created by the participant.
- Trainer analyzes the visual inspection techniques applied by the participant.
- Trainer reviews the damage analysis steps applied by the participant.
- Trainer checks the pre-flight checklist used by the participant.
- Trainer evaluates the participant's descriptions of common failures for any UAV component.

#### **END**

The trainer will stress that UAV safety relies on careful attention to detail. They will recap that even minor issues like cracks, loose connectors, or unusual sensor readings—can jeopardize missions. Emphasizing thorough inspections, documentation, and diagnostic checks, the trainer will reinforce that these practices prevent failures and ensure reliability. Finally, they will introduce the next lesson, “Common Malfunctions and Symptoms,” explaining that understanding typical UAV faults and their indicators is essential for early detection and effective troubleshooting.

## MODULE 2 – LESSON 2

# Common Malfunctions and Symptoms

## LESSON PLAN

### GENERAL INFORMATION

#### LEARNING ACQUISITIONS

At the end of the lesson, students will be able to:

- Understand telemetry data
- Analyze flight records
- Learn anomaly-based troubleshooting
- Understand sensor types and functions
- Identify and troubleshoot sensor malfunctions

#### TIME

2 lesson hours

#### METHODS AND TECHNIQUES

Direct Instruction & Presentation

Demonstration Method

Video-Based Learning

Hands-on / Experiential Learning

Project-Based Learning (PBL) (work on real-life drone repair projects to integrate theory and practice)

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## IMPLEMENTATION OF THE LESSON

### INTRODUCTION

#### GAINING ATTENTION AND MOTIVATION

UAVs are complex systems that rely on precise data, reliable sensors, and accurate communication to perform safe and stable flights. Even the most advanced UAVs can experience malfunctions that impact performance or safety. By learning how to interpret telemetry data, analyze flight records, and apply anomaly-based troubleshooting, UAV operators can detect problems before they become critical. Understanding sensor types and their functions also allows for early identification of issues such as drift, noise, or data loss—symptoms that may signal a deeper malfunction. Developing these diagnostic skills not only enhances safety and reliability but also builds confidence and professionalism in UAV operations.

### DEVELOPMENT

#### IMPLEMENTATION OF THE LESSON CORE

- Students watch Module 2 Video 6 and interpret telemetry data types (Resource 6)
- Students watch Module 2 Video 7 and analyze flight logs (Resource 7)
- Students watch Module 2 Video 8 and identify UAV anomalies and possible causes (Resource 8)
- Students watch Module 2 Video 9 and classify basic sensors, obstacle avoidance and specialized sensors (Resource 9)
- Students watch Module 2 Video 10 and examine the symptoms of sensor failure (Resource 10)
- Hands-on activity through working on UAV parts.

### SUMMARISING

#### LESSON SUMMARY (TRAINER'S APPROACH)

To conclude the lesson, the trainer will highlight how UAV operational safety depends on understanding the system's complexity and interconnectivity. The summary will emphasize that safe and stable UAV performance relies on accurate data, dependable sensors, and effective communication links. The trainer will revisit key points such as interpreting telemetry data, analyzing flight logs, and using anomaly-based troubleshooting to identify potential issues early. By connecting these skills to real-world scenarios, the trainer will reinforce how recognizing sensor-related problems—like drift or data loss—can prevent major failures. Finally, the session will close with a discussion on how mastering these diagnostic and safety techniques contributes to greater reliability, confidence, and professionalism in UAV operations.

### ASSIGNMENT

- List three key parameters that UAV technicians monitor to detect potential issues during a flight.
- Explain the difference between manufacturer-specific software (e.g., DJI Assistant 2, Autel Explorer) and open-source analysis tools (e.g., Mission Planner, PX4 Flight Review) in drone maintenance and data analysis.

- Explain two possible causes of unstable hover conditions in UAVs and describe how such anomalies can be detected.
- A UAV shows a significant decrease in flight time compared to previous missions. Identify three possible causes of this issue.
- Describe the main symptoms of an IMU failure and explain one corrective action that can be taken to fix it.

#### **EVALUATION OR TESTING**

- Trainer evaluates the steps to interpret telemetry data generated by the participant.
- Trainer evaluates the participant's command of flight log analysis software.
- Trainer evaluates the anomaly-based troubleshooting procedures implemented by the participant.
- Trainer assesses the participant's knowledge of UAV sensors.
- Trainer audits the participant's steps to identify and troubleshoot sensor failures.

#### **END**

The trainer will emphasize that UAV safety depends on understanding system complexity and interconnections. Key points like interpreting telemetry, analyzing flight logs, and detecting sensor anomalies will be reinforced, showing how early identification of issues prevents failures. Linking these skills to real-world scenarios, the trainer will highlight their role in ensuring reliability, confidence, and professionalism. Finally, the trainer will introduce the next lesson, "System Configuration and Maintenance," explaining that learning proper setup, calibration, and routine maintenance is crucial for keeping UAVs operational, safe, and mission ready.

## MODULE 2 – LESSON 3

# System Configuration and Maintenance

## LESSON PLAN

### GENERAL INFORMATION

#### LEARNING ACQUISITIONS

At the end of the lesson, students will be able to:

- Explain the purposes and steps of firmware updates
- Perform basic calibrations
- Understand the impact of environmental factors on flight performance
- Understand preventive maintenance principles
- Explain how to create a preventive maintenance schedule
- Demonstrate proficiency in the contents of manufacturer maintenance manuals

#### TIME

2 lesson hours

#### METHODS AND TECHNIQUES

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## IMPLEMENTATION OF THE LESSON

### INTRODUCTION

#### GAINING ATTENTION AND MOTIVATION

Understanding how to perform firmware updates keeps your UAV equipped with the latest features and security improvements. Mastering basic calibrations ensures accurate sensor and control responses, while recognizing environmental influences such as wind, temperature, and magnetic fields helps prevent flight anomalies. Moreover, applying preventive maintenance principles and creating a structured maintenance schedule reduces the risk of unexpected failures and extends the lifespan of UAV components. By following manufacturer maintenance manuals with proficiency, operators can maintain compliance and operational excellence. Developing these skills not only enhances flight safety but also builds confidence and professionalism in UAV operations.

### DEVELOPMENT

#### IMPLEMENTATION OF THE LESSON CORE

- Students watch Module 2 Video 11 and explain the firmware update steps (Resource 11)
- Students watch Module 2 Video 12 and explain the calibration steps for UAV components (Resource 12)
- Students watch Module 2 Video 13 and examine practices to mitigate the effects of environmental factors on the UAV (Resource 13)
- Hands-on activity through working on UAV parts.
- Students watch Module 2 Video 14 and identify maintenance actions (Resource 14)
- Students watch Module 2 Video 15 and develop a maintenance program according to time and cycle (Resource 15)
- Students watch Module 2 Video 16 and review a sample drone maintenance manual (Resource 16)
- Hands-on activity through working on UAV parts.

### SUMMARISING

To conclude the lesson, the trainer will summarize by highlighting how each concept contributes to safe and efficient UAV operation. The discussion will reinforce that performing regular firmware updates keeps systems secure and up to date, while mastering calibrations ensures precise control and reliable sensor data. The trainer will emphasize the importance of understanding environmental effects such as wind and magnetic interference in preventing flight anomalies. Finally, the summary will connect preventive maintenance and adherence to manufacturer manuals with overall reliability, safety, and professional standards. The trainer will close by encouraging learners to apply these practices consistently to build confidence and operational excellence in real-world UAV missions.

#### ASSIGNMENT

- Explain two key reasons why firmware updates are important for UAV performance and safety.
- List three essential preparations that should be completed before starting a firmware update process.
- List five types of drone parts that need calibration.
- List the environmental impacts that affect UAV performance.
- Describe the difference between preventive, corrective, and predictive maintenance in UAV operations.

#### EVALUATION OR TESTING

- Trainer evaluates the firmware update steps created by the participant.
- Trainer evaluates the calibration procedures implemented by the participant.
- Trainer assesses the participant's knowledge of the impact of any environmental factors on drone performance.
- Trainer inspects the maintenance actions steps prepared by the participant.
- Trainer reviews the maintenance program developed by the participant.
- Trainer evaluates the participant's mastery of the content of drone maintenance manuals.

#### END

The trainer will stress that safe and efficient UAV operation relies on regular firmware updates, precise calibrations, and awareness of environmental effects like wind or magnetic interference. Emphasizing preventive maintenance and following manufacturer manuals, the trainer will reinforce how these practices enhance reliability, safety, and professionalism. Finally, the session will introduce the next lesson, "Operational Safety and Troubleshooting," explaining that learners will apply these foundational skills to identify, analyze, and resolve operational issues, ensuring mission success and strengthening confidence in real-world UAV operations.

## MODULE 2 – LESSON 4

# Operational Safety and Troubleshooting

## LESSON PLAN

### GENERAL INFORMATION

#### LEARNING ACQUISITIONS

At the end of the lesson, students will be able to:

- Explain flight safety guidelines for test flights
- Identify key performance metrics in flight
- List post-flight controls
- Develop competence in documenting troubleshooting processes and results
- Create a component-based troubleshooting process steps step by step

#### TIME

1 lesson hour

#### METHODS AND TECHNIQUES

Direct Instruction & Presentation

Demonstration Method

Video-Based Learning

Hands-on / Experiential Learning

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Problem-Solving Approach

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Computer or tablet

## IMPLEMENTATION OF THE LESSON

### INTRODUCTION

#### GAINING ATTENTION AND MOTIVATION

Operational safety and troubleshooting are at the heart of every successful UAV mission. Whether during a routine test flight or in complex operational conditions, understanding how to maintain safety, monitor performance, and respond to issues ensures reliability and mission success. In this section, learners will explore essential flight safety guidelines for test operations, identify key in-flight performance metrics, and apply systematic post-flight checks. By developing skills in documenting troubleshooting procedures and designing standardized reporting forms, participants will gain the confidence and competence to manage UAV operations safely and efficiently minimizing risks while maximizing performance and data accuracy.

### DEVELOPMENT

#### IMPLEMENTATION OF THE LESSON CORE

- Students watch Module 2 Video 17 and list flight safety steps (Source 17)
- Students watch Module 2 Video 18 and analyze flight performance metrics (Source 18).
- Students watch Module 2 Video 19 and list post-flight checks (Source 19).
- Students watch Module 2 Video 20 and identify what needs to be in the troubleshooting document (Source 20).
- Students watch Module 2 Video 21 and list component-based troubleshooting steps step by step (Source 21).
- Hands-on activity through working on UAV parts.

#### SUMMARISING

To summarize the lesson, the trainer will highlight the importance of operational safety and systematic troubleshooting as core elements of UAV reliability. The session review will reinforce key learning points emphasizing adherence to flight safety guidelines during test flights, accurate monitoring of performance metrics, and thorough post-flight inspections. The trainer will then recap how effective documentation and the use of standardized troubleshooting forms support consistent maintenance and data-driven improvements. The trainer will outline the component-based troubleshooting steps step by step.

#### ASSIGNMENT

- Explain two actions a UAV operator should take if the drone encounters signal loss or low battery during flight.
- List three factors that directly affect a UAV's stability during flight and briefly explain why they are important.
- Describe two ways modern digital technologies (like cloud systems, AI, or IoT) improve UAV maintenance and troubleshooting efficiency.

- What are the first three steps you should take when inspecting a drone's frame, landing gear, and propellers for physical damage?
- List two methods for checking the health and functionality of a drone's battery and power distribution board.

#### **EVALUATION OR TESTING**

- Trainer evaluates the flight safety steps created by the participant.
- Trainer analyzes the flight performance criteria created by the participant.
- Trainer analyzes the post-flight checklist steps created by the participant.
- Trainer evaluates the troubleshooting template created by the participant.
- Trainer evaluates the troubleshooting steps for each component.

#### **END**

The trainer will emphasize that operational safety and systematic troubleshooting are essential for UAV reliability. Key points like following flight safety guidelines, monitoring performance metrics, conducting thorough post-flight inspections, and maintaining accurate documentation will be reinforced. The trainer will recap component-based troubleshooting steps, showing how structured analysis supports consistent maintenance and continuous improvement.

The trainer will create a narrative about the common outcome of all modules. Therefore, safe and efficient UAV operation relies on thorough record-keeping, accurate visual inspections, and systematic damage assessments. Pre-flight and post-flight checks, telemetry and flight log analysis, and anomaly-based troubleshooting ensure early detection of issues. Mastery of sensor functions, firmware updates, calibration, and awareness of environmental impacts enhances performance and reliability. Following maintenance principles, manuals, and structured procedures, including step-by-step troubleshooting, supports consistent, data-driven improvements.