Private Pilot Lesson Plan: Systems and Equipment Malfunctions (FAA-S-ACS-6C, Task IX.C)

Lesson Overview

Title: Systems and Equipment Malfunctions
Objective: By the end of this lesson, the student will demonstrate understanding of the causes, indications, and pilot actions for systems and equipment malfunctions, identify associated risks and mitigations, and describe appropriate responses to simulated scenarios, meeting the Knowledge (K), Risk Management (R), and Skills (S) elements of FAA-S-ACS-6C Task IX.C. This aligns with private pilot certification standards for emergency operations.
References:

- FAA-H-8083-25 (Pilot's Handbook of Aeronautical Knowledge): Covers aircraft systems, malfunctions, causes, indications, and basic pilot actions.
- FAA-H-8083-3 (Airplane Flying Handbook): Focuses on emergency procedures and practical responses during flight.
- FAA-H-8083-2 (Risk Management Handbook): Emphasizes risk identification, assessment, and mitigation related to malfunctions.
- Aircraft Pilot's Operating Handbook/Airplane Flight Manual (POH/AFM): Aircraft-specific checklists and procedures (use the training aircraft's model).
  Prerequisites: Student should have basic knowledge of aircraft systems from prior lessons (e.g., PHAK Chapters 7-9 on systems and instruments).
  Lesson Type: Ground instruction (1-1.5 hours), with potential follow-up in-flight simulation if aircraft equipped.
  Completion Standards: Student accurately describes causes, indications, and actions for at least three malfunctions from K1-K5, identifies associated risks and mitigations, and completes relevant checklists without prompting, achieving at least 80% accuracy per ACS standards.

Schedule

Phase	Duration	Description
Introduction	5 minutes	Review ACS Task IX.C objectives, references, and importance of malfunctions in emergency operations.
Knowledge Discussion	30 minutes	Cover K1-K5 elements using handbook excerpts and examples.
Risk Management	15 minutes	Discuss R1-R4 using RMH case studies and scenarios.
Skills Practice	20 minutes	Simulate malfunctions; student describes actions and completes checklists.
Review and Evaluation	10 minutes	Q&A, quiz on key points, and assignment for self-study.
Total	**80 minutes**	

Equipment Needed

- Whiteboard or digital presentation tool for diagrams (e.g., system schematics from PHAK).
- Printed excerpts from FAA-H-8083-25 (Chapters 7-9, 16-17 on systems, instruments, and emergencies), FAA-H-8083-3 (Chapter 18 on emergency procedures), and FAA-H-8083-2 (Chapters 3-6 on risk assessment and threat management).
- Training aircraft POH/AFM with emergency checklists.
- Visual aids: Diagrams of pitot-static, electrical, and fuel systems; sample checklists.
- Optional: Simulator software or mock cockpit for scenario practice.

Instructor Actions

- Present content using handbooks as primary sources; reference specific chapters (e.g., "See PHAK Chapter 7 for electrical system details").
- Use real-world examples from RMH case studies (e.g., fuel exhaustion due to poor planning).
- Facilitate discussion by asking open-ended questions (e.g., "What risks arise from ignoring a low voltage warning?").
- Simulate 3-5 malfunctions (e.g., via verbal scenarios) and evaluate student responses against ACS Skills.
- Provide feedback on risk mitigations and encourage use of POH/AFM.
- Assign homework: Review POH emergency sections and prepare a personal risk assessment for a sample flight.

Student Actions

- Actively participate in discussions, taking notes on causes, indications, actions, and risks.
- Ask clarifying questions and reference handbooks during explanations.
- For skills practice, verbally describe step-by-step responses to simulated malfunctions and demonstrate checklist usage.
- Self-assess risks in scenarios and suggest mitigations.

Content Outline

The lesson focuses on ACS Task IX.C elements. Use the tables below for structured teaching, drawing from the referenced handbooks.

Knowledge Elements (K1-K5)

Discuss each malfunction, integrating causes and indications from PHAK, procedures from AFH and POH/AFM.

Malfunction	Causes (from PHAK/AFH)	Indications (from PHAK/AFH)	Pilot Actions (from AFH/POH)
K1: Partial or Complete Power Loss (e.g., Engine Failure)	Fuel starvation (e.g., dry tank, vapor lock, contamination); mechanical issues (e.g., compressor stall in turbines); induction icing.	Engine roughness, power loss, rpm/manifold pressure drop, vibrations; complete stoppage.	Establish best glide speed; attempt restart (switch tanks, apply carb heat, mixture rich); select landing site; complete engine failure checklist; declare emergency if needed. Avoid low-altitude turns back to runway unless trained.
K2a: Electrical Malfunction	Alternator/generator failure; battery depletion; wiring shorts; circuit overloads.	Warning lights (e.g., low voltage, ammeter deflection); dim lights; avionics loss.	Shed non-essential loads (e.g., turn off radios/lights); reset circuit breakers once; notify ATC; land ASAP at nearest airport; prepare for no-flap/manual gear extension.
K2b: Vacuum/Pressure and Associated Flight Instrument Malfunctions	Vacuum pump failure (e.g., worn bearings, dirt); low pressure; gyro precession/drift.	Unstable attitude/heading indicators; vacuum gauge low; warning light; instruments tumble at extreme attitudes.	Cross-check with backup instruments (e.g., turn coordinator); cover failed instruments to avoid fixation; maintain control via partial panel; land ASAP.
K2c: Pitot-Static System Malfunction	Blockage (ice, insects, debris); leaks in lines.	Erratic/frozen altimeter, ASI, VSI (e.g., ASI decreases in descent if blocked); altimeter reads higher than actual.	Activate pitot heat; use alternate static source; cross-check with GPS/groundspeed; apply corrections per POH; continue flight cautiously or land.
K2d: Electronic Flight Deck Display Malfunction	Power loss; sensor failures (e.g., AHRS misalignment); data input interruptions.	Blank/erratic PFD/MFD; loss of attitude/heading data; outdated displays (e.g., NEXRAD latency).	Switch to backup/standby instruments; reduce electrical load; troubleshoot per POH; maintain manual control; avoid reliance on delayed data.
K2e: Landing Gear or Flap Malfunction	Hydraulic/electrical failure; mechanical jams; leaks.	Gear warning horn; failure to extend/retract; asymmetric flaps.	Use manual extension (e.g., hand crank); verify gear position visually or via mirrors; adjust approach

Malfunction	Causes (from PHAK/AFH)	Indications (from PHAK/AFH)	Pilot Actions (from AFH/POH)
			speed for no-flap landing; complete checklist.
K2f: Inoperative Trim	Cable breakage; electrical failure in trim system.	Control forces heavy; inability to trim for hands-off flight.	Manually hold controls; reduce speed to lessen forces; land ASAP; use autopilot if available for relief.
K3: Smoke or Fire Onboard	Fuel/oil leaks contacting hot surfaces; electrical shorts; exhaust cracks; maintenance errors.	Smoke odor; visible flames; warning lights; high EGT/oil pressure anomalies.	For engine fire: Mixture to idle cut-off, fuel off, ignition on to burn residual fuel; extinguish if possible; ventilate cabin; land immediately. For electrical: Isolate circuit, master off; use extinguisher; declare emergency.
K4: Other Aircraft-Specific Systems (e.g., Deicing, Oxygen)	Icing (e.g., structural/ induction); oxygen leaks or regulator failure.	Ice buildup on surfaces; hypoxia symptoms (e.g., dizziness); low oxygen pressure.	Activate anti-ice/deice systems preemptively; descend to warmer altitudes; don oxygen masks; monitor for performance degradation.
K5: Inadvertent Door or Window Opening	Latch failure; improper securing preflight.	Sudden noise/wind; cabin pressure changes; handling asymmetry.	Slow aircraft to reduce forces; do not attempt to close in flight if risky; maintain control; land normally.

Risk Management Elements (R1-R4)

Use RMH to teach identification, assessment, and mitigation. Reference case studies (e.g., fuel exhaustion due to poor planning) and tools like PAVE checklist or FRAT.

- **R1: Checklist Usage for Malfunctions:** Risk of incomplete or skipped checklists leading to escalation (e.g., forgetting to shed loads in electrical failure). Mitigation: Practice SRM; use "do-verify" method; prioritize aviate-navigate-communicate.
- **R2: Distractions, Task Prioritization, Loss of Situational Awareness, or Disorientation:** High workload from malfunction (e.g., instrument failure in IMC) causes fixation or startle. Mitigation: Use TEM to anticipate threats; slow aircraft; delegate tasks if multi-crew; maintain scan.
- **R3: Undesired Aircraft State:** Malfunction leading to stall, spin, or CFIT (e.g., power loss at low altitude). Mitigation: Build safety margins via preflight planning; use automation wisely; rehearse scenarios.

- **R4: Startle Response:** Sudden malfunction (e.g., fire alarm) causes panic. Mitigation: Train for recognition; breathe and assess; reference RMH on error management defenses like briefings and backups.

Skills Elements (S1-S2)

- **S1:** Student describes actions for at least three evaluator-selected scenarios (e.g., pitot blockage during climb: "Activate alternate static, cross-check instruments, continue cautiously"). Use verbal simulation.
- **S2:** Demonstrate checklist completion (e.g., engine fire checklist: Mixture off, fuel selector off, master off).

Evaluation and Notes

- Quiz: 5-10 questions (e.g., "What is the first action for an electrical fire?").
- Common Errors: Over-reliance on memory vs. checklists; ignoring risks like fuel mismanagement.
- Follow-Up: In-flight lesson to simulate malfunctions (if safe); review personal minimums for risks.
  This lesson promotes safe decision-making and prepares the student for the practical test.