### **✅ Topic Name**

**Zero-shot, One-shot, and Few-shot Prompting Techniques for Aerospace Engineers**

### **📌 Prompts Used**

* **Zero-shot Prompt** "Summarize anomalies and key observations from this log:  
   Altitude dropped from 36,000 to 30,500 ft in 45 seconds.  
   Cabin pressure spike at 12:21.  
   Autopilot disengaged for 18 seconds."
* **One-shot Prompt** "Example:  
   Input – Altitude fluctuated between 25,000 and 27,000 ft. Engine vibration rose to 2.5g at 14:23.  
   Output – Oscillating altitude noted. Engine vibration spike at 14:23 suggests imbalance or wind shear. Monitor engine dynamics.

Now analyze:  
 Input – Altitude dropped from 36,000 to 30,500 ft in 45 seconds. Cabin pressure spike at 12:21. Autopilot disengaged for 18 seconds."

* **Few-shot Prompt** "Example 1:  
   Input – Oil pressure drop in Turbine A. Rise in exhaust temp.  
   Output – Oil delivery issue detected in Turbine A. High exhaust temp may indicate bearing stress.

Example 2:  
 Input – Repeated surge in fan RPM. Noise reported in cockpit.  
 Output – Surge likely due to fan imbalance. Acoustic signal supports turbine blade inspection.

Now analyze:  
 Input – Engine 2 compressor stall at 13:02. Flameout warning followed. Restart took 16 seconds."

### **✅ Topic: Instructional and Analytical Prompts for Aerospace Engineers**

1. "Generate a test SOP for vibration qualification of satellite payloads using sine sweep from 5Hz to 100Hz."
2. "Analyze vibration test results: 3-axis accel peak = 14g at 42Hz. Deviation exceeds spec limit. What’s the likely cause?"

### **✅ Topic: AI for Conceptual Aircraft and Spacecraft Design**

1. "Design an aircraft for long-endurance surveillance missions. Cruise speed ~450 knots, range >5000 km, must operate at 40,000 ft. Recommend configuration, wing type, propulsion, and payload bay design."
2. "Design a satellite for thermal imaging of Earth’s surface. Orbit: Sun-synchronous, altitude ~700 km. Include thermal payload, power system, ADCS, and communication subsystem."
3. "Compare a canard-configured pusher drone with a traditional tail-boom layout. Payload: 5kg, cruise: 80 knots, range: 150 km."

### **✅ Topic: Multi-modal Generation of Wing, Fuselage, and Structure Variants**

1. "Suggest three wing variants for a UAV designed to cruise at 0.9 Mach at 40,000 ft. Must optimize for reduced drag and stability in crosswinds."
2. "Based on the table below, suggest 2 fuselage cross-section variants:

Volume (m³) Pressure Limit (psi) Length (m)  
 42 9.5 26"

1. "Attached: Previous wing sketch (delta wing). Design two variants for subsonic stability and structural strength enhancement. Maintain span under 20m."

### **✅ Topic: Prompting for Preliminary BOMs and Weight Estimates**

1. "Create a high-level BOM for a twin-turboprop surveillance aircraft with retractable landing gear, EO/IR payload, range 3,500 km, ceiling 35,000 ft."
2. "Estimate the empty weight of a UAV with carbon-fiber fuselage (6m), lithium-ion battery pack, fixed tricycle gear, and dual-sensor payload."
3. "Fill in weight estimates and top contributors for the following BOM:

Component Material Estimate (kg)  
 Wing Composite ?  
 Payload (camera) Electronics ?  
 Batteries Li-Ion ?  
 Landing Gear Steel Alloy ?"

### **✅ Topic: Generating Mission-Specific Design Options Using AI**

1. "Design two UAV configurations for 40,000 ft cruise altitude, endurance >20 hrs, equipped with synthetic aperture radar. Operate from short runways."
2. "Suggest two design variants for a robotic lunar lander that must deliver 200 kg payload to Mare Serenitatis. Descent speed ≤2 m/s, solar-powered, low thermal loss."
3. "Generate two design options for a single-seat supersonic interceptor: max speed Mach 2.2, range 800 km, must carry 2 air-to-air missiles."

### **✅ Topic: Generative Prompts for Stress, Fatigue, and Load Cases**

1. "Define a static stress load case for an aluminum wing spar under 3.5g maneuver load. Wing span: 24m, load distribution elliptical."
2. "Create a fatigue test scenario for nose gear subjected to 4 cycles per day, over 10 years, on mixed runways."
3. "Summarize fatigue performance of titanium blade:

Test temp: 650°C  
 Cycles to failure: 92,300  
 Crack observed at 8 o'clock edge  
 Stress amplitude: 190 MPa"

### **✅ Topic: Anomaly Detection in Simulation Results Using AI**

1. "Identify anomalies in CFD pressure output at Mach 0.88. Noted: spike near wing root, trailing edge oscillation."
2. "Review FEA stress simulation of fuselage joint under cyclic loading. Identify zones exceeding 60% of yield over 10,000 cycles."
3. "Scan modal frequencies for a 12U satellite structure. Nominal: 1st mode = 28 Hz. Simulation reports shifts at elevated temp."

### **✅ Topic: AI Summarization of Performance and Test Metrics**

1. "Summarize elevator deflection vs pitch rate data for Test 18. Input: elevator = 5° to 15°, pitch rate response = 4.2°/s to 8.7°/s."
2. "Summarize Cl and Cd trends for angle of attack from -5° to 20°. Peak lift at 14°. Notable stall at 16°."
3. "Summarize engine thrust performance. Input: N1 = 93–97%, thrust = 18.2–19.4 kN, fuel flow = 0.89–0.96 kg/s."

### **✅ Topic: Jet Engine and Rocket Motor Design via Prompting**

1. "Design a medium-bypass turbofan engine for a regional aircraft cruising at Mach 0.78, 38,000 ft. Prioritize fuel efficiency and low noise. Thrust ~80 kN."
2. "Design a solid rocket motor for first-stage lift of a micro launcher. Payload mass: 65 kg to 500 km orbit. Burn time: ~55s. Thrust: ~90 kN."
3. "Generate propulsion concept for a vehicle requiring rocket boost to Mach 2.5 and ramjet operation to Mach 6. Include transition logic."

### **✅ Topic: Generating Cooling Systems and Combustion Modeling Using AI**

1. "Design a combustion chamber for a liquid bipropellant engine (LOX + kerosene). Target: 50 kN thrust, chamber pressure ~7 MPa, burn time 65s."
2. "Suggest regenerative cooling design for the above combustion chamber using kerosene as coolant."
3. "Estimate combustion efficiency and emissions for a can-annular jet combustor running Jet-A at 15:1 air-fuel ratio, T3 = 850 K, P3 = 1.9 MPa."

### **✅ Topic: AI for Material Selection and Fatigue Prediction**

1. "Recommend material for a wing spar on UAV cruising at Mach 0.82, altitude 39,000 ft. Prioritize high specific strength, corrosion resistance, low weight. Must sustain 3.8g loading."
2. "Predict fatigue life of 300M steel strut under 160 kN load, 1,200 cycles/week, for 6 years. Include runway shock factor of +10%."
3. "Compare graphite vs tungsten-copper alloy for use in a rocket nozzle throat at 3,200 K chamber temp."

### **✅ Topic: Prompt-Based Analysis of Propulsion Failures and Efficiency**

1. "Analyze compressor stall at 13:06: N2 spike from 91% to 97%, Tt3 surge from 780K to 1050K, sudden drop in P3. What caused it?"
2. "Summarize rocket test: chamber pressure = 6.8 MPa, thrust = 64.2–63.1 kN over 58s, propellant flow = 2.1 kg/s."
3. "At 45,000 ft test run, turbine inlet temp spiked to 1650K, blade cooling margin exceeded. What’s the likely failure mechanism?"

### **✅ Topic: Prompting for Avionics System Logic and Functional Narratives**

1. "Describe avionics logic for UAV mission: manual takeoff, autopilot cruise, return to manual landing. Include GPS, IMU, and altitude input dependencies."
2. "Generate avionics logic for LEO satellite: include deployment, detumble, sun-tracking, communication windows, and safe mode fallback."
3. "Describe avionics failover behavior if primary IMU fails. Include logic for backup activation and alert protocols."

### **✅ Topic: PID Controller and Auto-Pilot Prompt Generation**

1. "Tune PID loop for pitch angle stabilization on UAV: weight = 14 kg, speed = 90 knots, control surface delay ~0.3s."
2. "Describe autopilot altitude hold logic for a turboprop aircraft. Cruise altitude = 18,000 ft. Include sensor input flow and error correction strategy."
3. "Generate phase-specific PID gains for vertical control (climb, cruise, descent) in a regional jet."

### **✅ Topic: Navigation Fault Scenarios and AI-Powered Recovery Logic**

1. "During cruise at 2,000 ft, UAV GPS signal is lost. IMU and barometer still functional. Suggest navigation fallback logic."
2. "Spacecraft IMU drift detected >4°/hr during reentry. GPS intermittent. Star tracker inactive due to plasma blackout. Propose fallback."
3. "UAV loses both GPS and radar altimeter during low-altitude urban flight. Suggest multi-sensor navigation fallback."

### **✅ Topic: Real-Time Flight Data and Telemetry Summarization**

1. "Summarize the last 5 minutes of telemetry:

Altitude: 12,500–13,200 ft  
 IAS: 216–222 knots  
 Tq1/Tq2 = 91%/89%  
 Fuel Flow = 510 kg/hr  
 No warning flags."

1. "Summarize this telemetry snapshot:

Alt: 24,100 ft  
 Cabin Alt: 8,120 ft → 8,850 ft  
 Pressure trend: ↑  
 Rate: 450 ft/min  
 Warning: Cabin pressure amber"

1. "Summarize last 3 orbits:

Battery: 92% avg  
 Temp: 28–33°C  
 ADCS mode: fine tracking  
 Comm: 3 passes, 2 nominal, 1 dropped frame"

### **✅ Topic: Orbital Mechanics and Trajectory Optimization Prompts**

1. "Calculate Hohmann transfer from 400 km circular LEO to GEO (35,786 km). Assume standard Earth gravity and initial circular velocity."
2. "Estimate ΔV to change inclination by 20° at 800 km altitude. Mass = 600 kg satellite. Velocity = 7.45 km/s."
3. "List next 3 Earth–Mars Hohmann windows starting 2026. Include ΔV and estimated flight times."

### **✅ Topic: Spacecraft Subsystem Configuration with AI**

1. "Generate subsystem layout for 3U CubeSat in 500 km SSO. Payload = 1U hyperspectral camera. Mission: 18 months, 3 daily passes."
2. "Compare trade-offs:  
    A) 120W panel + 45 Wh battery  
    B) 90W panel + 70 Wh battery  
    Assume eclipse duration = 30 min, payload draw = 60W."
3. "Define redundancy for comms: dual S-band transmitters, single receiver. Mission = 5 years, 2 passes/day."

### **✅ Topic: Generating EDL (Entry, Descent, Landing) Sequences with AI**

1. "Generate EDL sequence for 250 kg Mars lander, Jezero Crater, entry speed ~5.4 km/s, target alt = 0 m, wind shear risk."
2. "Generate EDL sequence for 400 kg lunar lander. Initial altitude: 15 km, vertical descent. Include retro-thrust staging."
3. "EDL in progress. Fuel margin drops below 8% at 900 m. Suggest abort or contingency logic."

### **✅ Topic: Prompting for Mission Planning and Deep Space Risk Logs**

1. "Generate 8-phase mission plan for Mars orbiter launched in 2026. Cruise: 8 months. Include comm windows, burn checkpoints, and entry into orbit."
2. "Create 5-item deep space risk log for a probe operating near L2. Focus on radiation, thermal limits, and DSN communication gaps."
3. "Probe deviates 0.9° from nominal trajectory during solar sail maneuver. Max allowable: 0.5°. Propose recovery steps and triggers."

### **✅ Topic: Pre-Flight Checklist Generation and Test Setup Prompts**

1. "Generate pre-flight checklist for fixed-wing UAV with EO/IR sensor, S-band link, and triple-redundant IMU. Mission = 5-hour surveillance."
2. "Generate bench test setup plan for CubeSat avionics validation. Include EPS, OBC, ADCS, comms interfaces."
3. "From UAV pre-flight checks, generate GO/NO-GO table with pass/fail criteria."

### **✅ Topic: Summarizing Wind Tunnel, Thermal, and Structural Tests with AI**

1. "Summarize test at Mach 1.8: inlet pressure recovery, shock position stability, drag coefficient vs AoA, flow separation."
2. "Summarize thermal vacuum cycling:  
    Temp range: –45°C to +72°C  
    Cycles: 8  
    Sensors: 5 locations  
    Failure criteria: ΔT ≤ 5°C between cycles"
3. "Summarize static load test:  
    Spar length = 6.4 m  
    Test load = 1.5× limit  
    Max strain = 0.39%  
    Crack/no-crack check: post-inspection."

### **✅ Topic: Post-Flight Log and Black Box Data Summarization Using AI**

1. "Summarize post-flight log:

Takeoff: 07:14  
 Climb to FL330 in 19 min  
 Cruise: 54 min at 462 KTAS  
 Minor turbulence at 31,000 ft  
 Landing: 09:12  
 No system warnings or pilot alerts"

1. "Summarize flight disturbance event:

Altitude drop: 2,200 ft in 32 sec  
 Pitch rate: peaked at –5.1°/s  
 Autopilot disengaged at 13:41:02  
 Manual input: full nose-up trim  
 Cabin: unsecured object alert"

1. "Summarize UAV post-flight:

Flight time: 3 hr 22 min  
 Battery residual: 18%  
 EO/IR sensor runtime: 82% mission duration  
 GPS loss: 2.3 min  
 Max altitude: 2,650 ft AGL"

### **✅ Topic: FMEA and Root Cause Narratives Using Generative AI**

1. "Create FMEA entry for rudder actuator freezing at 37,000 ft. Root cause: fluid viscosity spike in cold soak. Detection: abnormal rudder lag. Effect: yaw instability. Action: switch to low-temp hydraulic fluid."
2. "Write a root cause narrative: Elevator deflection anomaly at FL320. Test logs show delay in command relay from FCC-1. Flight data: latency spike >300 ms at 13:29:42. Suspected cause: intermittent bus error on CAN-B."
3. "Summarize FMEA for:

Hydraulic pump cavitation

Avionics boot-up lag

Landing gear sensor fault"

### **✅ Topic: Generating Compliance Reports for FAA, EASA, and ISO Using Generative AI**

1. "Generate FAA compliance report summary: Avionics firmware updated to v2.1. Functional tests passed on FCC, ADC, and GPS modules. EMI/EMC tests met DO-160. Reference Test Reports TR-073, TR-074."
2. "Summarize EASA CS-25 compliance: Fuselage fatigue tested to 100,000 cycles. No fracture or permanent deformation. Compliance with CS 25.571 (b) and AMC 20-20. Fatigue crack growth within thresholds."
3. "Create ISO 9001 QMS log: One NCR for defective harness connector in Lot B27. Root cause: crimping tool misalignment. Action: tool recalibrated and 100% inspection added. Lot quarantined. Clause 8.5.1 impacted."

### **✅ Topic: AI-Driven Technical Manuals and Maintenance SOPs**

1. "Create SOP: Landing Gear Retraction Test. Equipment: hydraulic test bench, pressure gauges. Pre-checks: system hydraulic pressure, strut alignment. Safety: chocks in place. Procedure: simulate gear retraction cycle."
2. "Translate technical content: ‘Inspect hydraulic reservoir level before each flight. Refill if below 70%. Use MIL-H-5606 fluid only.’ → Spanish"
3. "Create IPC entry for Engine Mount Assembly: Bracket (P/N EM202), 4 bolts (P/N B400), 2 bushings (P/N BU225), and reference Diagram 14.2"

### **✅ Topic: Prompting for Safety Audits and Risk Logs**

1. "Create a safety audit checklist for the aircraft’s avionics bay. Focus on wiring integrity, cooling systems, connector locks, and fire risk points."
2. "Log a safety risk: High-voltage cable near bay-4 has visible insulation fray. Immediate action needed. Risk of arc fault."
3. "Summarize safety risks logged between August 20–26. Group by system. Highlight unresolved critical issues."

### **✅ Topic: Quality Control Narratives for Manufacturing and Inspection**

1. "Generate a quality control narrative for part P0063: OD = 48.6mm (target: 50±0.5mm), Ra = 4.3μm (target: ≤3.2μm)."
2. "Summarize quality inspection for Turbine Blade Lot #9471. Include Pass/Fail per unit and dimension issues."
3. "Draft final QC report summary for Flap Assembly P0027. Fit check complete. Observations logged: hinge friction (left side), minor fastener misalignment."