

Private Pilot Ground Instruction

This syllabus is designed for a 12 week course aimed at instructing a Private Pilot student in all the required written knowledge including aerodynamics, aircraft systems, FAA regulations, weather, cross country navigation, and medical factors of flight. This course will make use of the following text books:

1. Pilot's Handbook of Aeronautical Knowledge (AC 61-23C)
2. Airplane Flying Handbook (FAA-H-8083-3)
3. A copy of the FAA written test organized by topic. The ASA Private Pilot Test Prep 2001 book was used to prepare this syllabus (ASA-TP-P-01)
4. A current copy of the FAA Regulations and the Airman's Information Manual (FAR/AIM, or CFR/AIM)

The FAA specifically requires ground instruction in the following topic areas (FAA §61.105)

1. FAA Regulations, applicable parts of sections 61,67, and 91
2. Accident reporting requirements for the NTSB
3. Use of the AIM and FAA Advisory Circulars
4. Use of Sectional charts for VFR navigation, using pilotage, dead reckoning and radio navigation systems.
5. Radio Communications Procedures
6. Recognition of critical weather situations from ground and in flight, windshear avoidance, and the procurement and use of aeronautical weather reports and forecasts.
7. Safe and efficient operation of aircraft including collision avoidance, and recognition and avoidance of wake turbulence
8. Effects of density altitude on takeoff and climb performance.
9. Weight and Balance calculations
10. Principles of Aerodynamics, powerplants and AC systems
11. Stall awareness, spin entry, spins and spin recovery techniques
12. Aeronautical Decision Making and judgment
13. Preflight action that includes
 1. how to obtain information on runway lengths at airports of intended use, data on takeoff and landing distances, weather reports and forecasts, and fuel requirements
 2. how to plan for alternatives if the planned flight cannot be completed.

In addition to the text books, a sectional chart, E6-B flight computer (analog or digital), a plotter, and a copy of the Aircraft Facility Directory (AFD) will be used. The sectional and AFD need not be current.

Lesson 1: Aerodynamics, Stability and Control

Pre-Lesson Reading: PHoAK, pp 1-17

Post-Lesson Practice: ASA Ch 1

Topics:

I. Fundamentals of Aerodynamics

1. 4 Fundamentals of Flight (time, money, FAA regulations and hanger rent)
2. Two types of drag: induced and parasite
3. Factors effecting each type of drag (aerodynamic shape, wing area, air speed, altitude)
4. Force Balance in level flight; relationship of weight and balance and horizontal tail loads

II. Aircraft Controls

1. Ailerons, rudder, elevator, trim tab

III. Engine Effects

1. How the propeller works
2. Torque
3. Gyroscopic Precession
4. Asymmetric Loading (P-Factor)
5. Spiraling Slipstream
6. What does this all mean? ***RIGHT RUDDER!***

IV. Airplane Stability and Control

1. Stability types: static and dynamic
2. Positive, Neutral and Negative Stability
3. Stability in each axis: longitudinal, lateral and directional
4. Typical Light Airplane S&C
5. Factors affecting airplane S&C: dihedral, VT sizing, wing sweep

Lesson 2: Load Factors, Aircraft Systems

Pre-Lesson Reading: PHoAK, Ch 1, pp17-24, Ch 2 all

Post-Lesson Practice: ASA Ch 1, p10, Ch2 all

I. Load Factors in Turning Flight

1. Aircraft Design Load factors
2. Load factors due to pitch and turbulence
3. Effect of airspeed on load factors
4. Centrifugal force and Component force vectors in a turn
5. Effect of Load factors on drag and stall speed

II. Airplane Flight Controls

1. Ailerons, differential movement and adverse yaw
2. rudder and rudder trim
3. elevator and elevator trim
4. flaps and maximum flap operating speeds
5. mechanics - cables and push-rods
6. landing gear - linkage, types

III. Electrical System

1. Powers all radios, lights, and, depending on the aircraft, some gyros and flaps, landing gear etc.
2. Alternator and Generator - differences
3. Electrical system outline: alternator, battery, main bus, circuit breakers
4. Amp Meter, alternator warning light

IV. Standard Light Aircraft Piston Engines, controls and operations:

1. Controls: Starter, Throttle, Mixture, Carburetor Heat (unless injected)
2. Fuel: 80/100/100LL, Car Vs. Aircraft octane, colors, Contaminant Precautions.
3. Refueling procedures: Grounding Wire, Check Sumps for Water & Dirt
4. Cooling, OT, CHT, EGT, Cowl Flaps, shock cooling precautions.
5. Ignition System: independent Magnetos
6. Need for and use of Carburetor Heat.
7. Oil system: Why aircraft engines use more oil.

V. Fuel System

1. Tanks, tank venting
2. Gravity feed, and fuel pumps, Fuel Pressure Gauge
3. Sumps, gascolator and Primer

VI. Propeller

1. Pitch Angle Vs. Radius
2. Fixed Pitch Vs. Constant Speed

VII. Aircraft Documents and Paperwork

1. Required documents AROW
2. Pilot Vs. Owner Responsibilities
3. Maintenance and Inspections required
4. Pilot Permitted work vs. A&P only work
5. Repairs and Alterations, Airworthiness Directives (ADs), Deferred Repair, and MEL

Lesson 3: Instruments

Pre-Lesson Reading: PHoAK, Ch 3 all

Post-Lesson Practice: ASA Ch 3 all

I. Pitot Static System

1. Inlets: Static port(s) and Pitot Tube
2. Instruments: ASI, VSI and Altimeter
3. Symptoms of a blocked pitot tube, or a blocked static port
4. Use of Alternate Static Source
5. Altimeter: design, function, effects of non-standard temperature Setting the Altimeter, field elevation Vs. Reported Setting, 75ft difference maximum. "*High to Low Look out Below! (or hot to cold)*"
6. Types of Altitude: Absolute, Indicated, Pressure, True and Density
7. Vertical Speed Indicator: Altimeter with a Calibrated leak
8. Airspeed Indicator: Differential Pressure gauge.
9. Types of Airspeed: Indicated, Calibrated and True.
10. ASI Markings - white, green and yellow arcs, Redline, V-Speeds

III. Magnetic Compass

1. Differences between magnetic and true north - called **variation**
2. Errors induced by mounting - **deviation**
3. Problems and errors using the magnetic compass
 - North-South Turning errors (starting at a heading near N or S)
 - Turning **to** N or S errors
 - East-West Acceleration Errors

Lesson 4: Gyroscopic Instruments, Intro to AIM/FAR.

Pre-Lesson Reading: PHoAK, Ch6 - all, AIM AIM 4-3-1 through 4-3-11. **Bring a copy of the AFD and a Sectional Chart, and bring the FAR/AIM**

Post-Lesson Practice: ASA Ch 4 - at your own pace, and ASA Ch 5 pp 1-17, 25-27

I. Gyroscopic Instruments

1. Three Gyroscopes: Attitude Indicator (AI), Directional Gyro (DG) and Turn & Bank
2. Electrical Vs Vacuum Driven
3. Principles of the Gyroscope: Fixed in Space, and Precession.
4. Turn Coordinator (or Turn & Bank) - **rate** information **only!**
5. Heading Indicator (DG): Must be set to magnetic at semi-frequent intervals
6. Attitude Indicator: should be checked for wings level, is self-correcting, but *can tumble if limits of bank and pitch are exceeded.*

II. Use of Primary Instruments

1. Concept of Primary and Secondary Instruments for each Phase of flight:
2. Straight and Level: Altimeter, DG
3. Steady State Climb: ASI, DG
4. Steady Turn: Turn Coordinator, Artificial Horizon
5. Constant Descent: ASI or VSI, and DG

III. FAA Regulations - Reading the thick Book and other cures for Insomnia

1. FAR's - Relevant Sections, how to use the FAR, and the AIM
2. §61 - Airman Certification
3. §67 - Medical Certificates
4. §71 - Airspace (But reading the AIM is MUCH easier)
5. §91 - General Operations
6. §830 - NTSB Accident Reporting Requirements

IV. AIM - What it is and What to Read

V. Airport Traffic Patterns

1. Wind Indicators and Segmented Circles
2. Standard Uncontrolled airport traffic patterns - proper pattern entry and exit
3. Radio Calls at uncontrolled airports
4. Special Patterns - Airspace avoidance, noise abatement etc.

Lesson 5: Airport Operations

Pre-Lesson Reading: PHoAK, Ch6 - all, Ch 7 all, AIM AIM 4-3-1 through 4-3-11, AIM Chapter 3 - all.

Post-Lesson Practice: ASA Ch 4 - at your own pace, and ASA Ch 5 pp 1-17, 25-27

II. Airports

1. Uncontrolled Airports
2. Tower Controlled Airports
3. Class B Airspace Airports

III. Airport Markings

1. Runway Markings
2. Taxiway Markings
3. Other Signs (VOR check circle, Noise Abatement etc.)

IV. Sources of Airport Data

1. Airport Facility Directory (AFD): How to read the cryptic little bugger
2. Sectional Chart Airport Symbols
3. 3rd Party Airport Information - AOPA guides, Air Guide etc.
4. NOTAMs

V. Airport Lighting

1. Minimum Lighting - runway lights, VFR and IFR
2. Rotating Beacons - civil and military
3. Approach Lighting - VASI, PAPI

VI. Communications

1. Radio Communications - establishing Radio Contact (*Note: please read the "Elements of Radio Communications" in my Private Pilot syllabus.*)
2. Radar Availability, use of Mode C, and VFR Traffic Following

VII. Collision Avoidance

1. Effective Traffic Scans - Day and Night
2. VFR Cruising Altitudes, areas of highest collision probability
3. Right Of Way Rules - in cruise and in the traffic pattern
4. Aircraft lights for Night Collision Avoidance.

VIII. Airspace

1. Classes of Airspace: A,B,C,D,E and G
2. Meaning of the terms "controlled" and "uncontrolled" airspace.
3. Pertinent Regulations: Weather minimums, Required equipment and endorsements.
4. Required Radio procedures
5. Special Use Airspace; MOAs, Prohibited, Restricted, Warning and Alert Areas, along with the ADIZ, and MTRs
6. Published VFR Routes.

Lesson 6: Biomedical and ADM, Weather - Part 1

Pre-Lesson Reading: PHoAK, Ch 9 AIM AIM Chapter 8 - all.

Post-Lesson Practice: ASA Ch 4 pp 9, 20 ASA Ch 5 pp 17-24,

I. Medical Certificates

1. Obtaining a First 2nd or 3rd class medical
2. Duration of the certificates
3. Student Pilot Medical
4. When is your medical *not valid*?

II. Health Factors in Flight

1. Fatigue, Anxiety and Stress
2. Chemicals: Alcohol, and Tobacco. Prescription and Non-Prescription drugs (dramamine, sudafed, anything which induced drowsiness or impairs decision making)
3. Checklist: **IM SAFE**

III. Environmental Factors related to Flying

1. Hypoxia - increased problem at Night. FAR §91.211 for supplemental Oxygen requirements.
2. Carbon Monoxide
3. Motion Sickness
4. Pressure Change problems (Ear, Sinus blockage)
5. Decompression after Scuba Diving
6. Illusions and Spatial Disorientation; Inner Ear confusion, Terrain illusions, Night Illusions, Runway width and length illusions, false horizons

IV. ADM - Aviation Decision Making

1. Identifying Hazardous Attitudes and behavioral Traps
 - a) Peer Pressure
 - b) Get-There-Itis
 - c) Expectations Vs. Reality
2. Recognizing and Coping with Stress
3. Risk Assessment Skills
4. the **DECIDE** Model (Detect, Estimate, Choose, Identify, Do and Evaluate)

V. Weather

1. Introduction to Weather
2. Weather Resources Available to the Pilot
 - a) AFSS recorded weather
 - b) GTE DUATS on the web
 - c) AOPA's weather pages
 - d) NOAA's weather pages
 - e) Other Web Sites (wunderground.com, the UW Weather index)
 - f) Classical charts, METARS, TAFs etc.
3. In Flight weather updates
 - a) Flightwatch (FSS) on 122.0
 - b) HIWAS, ASOS, AWOS

Lesson 7: Aviation Weather

Pre-Lesson Reading: PhoAK: Chapter 5, "Aviation Weather" - browse

Post-Lesson Practice: ASA Chapters 6 and 7

I. Atmospheric Physics

1. Nature of the atmosphere - basic make up, and changes with altitude
2. Weather Observations: balloons, commercial aircraft, Radar and PIREPs
3. Coriolis force and Global Circulation
4. Flow around High and Low Pressures Zones
5. Convection and Obstruction Turbulence
6. Surface Weather Maps

II. Moisture and Temperature

1. Humidity, Dewpoint and Fog
2. Types of Fog; radiation, advection, upslope, precipitation and steam
3. Effects of Temperature and Density on Flight Performance
4. Frost
5. Clouds and Ceilings - quick ceiling estimation, types of clouds and naming conventions.
6. Thunderstorms - stages of Development and dissipation.
7. Wind Shear
8. Icing
9. Cold front and Warm front weather patterns, occluded fronts

III. Aviation Weather Reports

1. Written Weather Reports and Forecasts:
 - a) METAR - routine weather reports
 - b) TAF - Terminal Area Forecasts
 - c) RAREPs - Radar Weather Reports
 - d) FA (Area Forecast), FD (Winds Aloft Forecasts)
 - e) AIRMET, SIGMET and Convective SIGMET.
 - f) PIREPs
2. Weather Charts
 - a) Surface Analysis Charts
 - b) Weather Depiction Chart
 - c) Radar Summary Chart
 - d) Significant Weather Prognostic Charts
 - e) Low Level Prognostic Charts

Lesson 8: Aircraft Performance, Weight and Balance

Pre-Lesson Reading: PhoAK: Chapter 4. Obtain a POH if possible

Post-Lesson Practice: ASA Chapter 8

I. Weight and Balance

1. Effect of Weight on Aircraft Performance
2. Center of Gravity; location and effect on performance, Stability and Control.
3. Basic Physics of Weight and Balance: $F1D1 = F2D2$.
4. Aircraft Datum, moment arms and Center of Gravity envelope.
5. Determining Weight and Balance using a POH
 - a) Number Crunching - all weights and arms
 - b) Graphical Method (when provided by the POH)
 - c) Table Method (when provided by the POH)
 - d) Shifting Weight to get back into the envelope
 - e) Check BOTH ends of flight - fuel burn can change things!

II. Aircraft Performance

1. Factors Which affect performance: Aircraft weight and Flight Environment
2. Density Altitude; Calculating and effect on Performance

III. Take Off

1. Density altitude and Humidity
2. Headwind / Tailwind Component
3. Runway surface roughness and gradient
4. Ground Effect and Soft Field Procedures
5. Take Off Performance Charts; Ground roll and 50' obstacle clearance

IV. Cruise

1. Ground Speed Calculation
2. Power Settings, Leaning and Fuel Burn

V. Landing

1. Approach and Landing Distances from Graphs
2. Effects of Density altitude on touch down speed
3. Runway Surface effects
4. Crosswind Components

Lesson 9: Navigation

Pre-Lesson Reading: PhoAK: Chapter 8. Obtain a POH if possible

Post-Lesson Practice: ASA Chapters 9 and 10

I. Aeronautical Charts

1. Sectional, WAC and Terminal Area Charts
2. Basic Chart Orientation; Latitude and Longitude, Magnetic Variation
3. Chart Legends; reading the Sectional Chart
 - a) Terrain features and Visual Landmarks
 - b) Airport Information
 - c) Radio Navigation and Communications Information
4. Chart Expiration Frequency

II. Course Planning; Pilotage and Dead Reckoning

1. Choosing a course (affected by Terrain, airspace, use of nav-aids, proximity to landmarks and civilization)
2. Planning Altitudes, total estimated times, fuel burn etc.
3. Checking information for the intended destination and possible alternate airports

III. Course Leg Planning

1. For each leg the following information needs to be gathered:
 - a) True Course and Magnetic Course (for altitude selection)
 - b) Minimum Altitude and Desired Altitude
 - c) Distance
 - d) Winds Aloft Forecast
2. From this information the pilot then calculates
 - a) True Course and Magnetic course corrected for wind
 - b) Ground speed corrected for wind
 - c) Leg Time and Fuel Burn
3. Also for each leg relevant frequencies and airspace should be noted

IV. Radio Aids to Navigation

1. Types of Radio Navigation Facilities: VOR, NDB and GPS
2. Using the VOR; radials, tune & ident, tracking to and from a station
3. Using an NDB (but why?)
4. GPS - you're on your own

V. Filing a Flight Plan

1. What a VFR flight plan does (and does not) provide for the pilot
2. When a VFR flight plan is *required*
3. Information in the flight plan
4. Opening and closing the flight plan (and what happens if you forget...)

VI. Enroute Aids to the Pilot

1. Flight Following
2. Flight Watch for weather updates, filing PIREPS etc.
3. HIWAS, TWEB and ASOS/AWOS transmissions (and ATIS of course)