DAY TWO
Simulator

- **Attitude Instrument Flying (Basic 4)**
- **VOR Orientation and Tracking**
- **Hold Entries**

Complete the power settings for your airplane.

TAKEOFF	Pitch _____°	Power _____MP	_____RPM
CLIMBS	Pitch _____°	Power _____MP	_____RPM
CRUISE	Pitch _____°	Power _____MP	_____RPM
ENROUTE DESCENT	Pitch _____°	Power _____MP	_____RPM
APPROACH LEVEL	Pitch _____°	Power _____MP	_____RPM
APPROACH DESCENT	Pitch _____°	Power _____MP	_____RPM
PRECISION DESCENT	Pitch _____°	Power _____MP	_____RPM
NON PRECISION DESCENT	Pitch _____°	Power _____MP	_____RPM
MISSED APPROACH	Pitch _____°	Power _____MP	_____RPM

Example Configuration Setting for PA 28-181		
Condition	**Power**	**Result (Kts)**
Climb	Full	V_Y 76 or V_X 64
Cruise	2400	125
Approach Level	2000	100
Approach Level (1 notch)	2000	90
V_A	2000	100
Slow Flight (Flaps)	1800	60
Slow Flight (No Flaps)	1700	60
Normal Descent & Precision Descent	1600	90 @ 500 FPM
Non Precision Descent	1300	90 @ 800 FPM
Pattern (Downwind)	2000	100
Numbers	1600 (Flaps1)	90
Base	1600 (Flaps 2)	80
Final	Required (Flaps 3)	70

Airspeeds for Various Configurations	
Best Glide	76
V_A	89-113
V_X	64
V_Y	76
V_{SO}	49
V_{S1}	55
V_R	50-60
V_{FE}	102
V_{NO}	125
V_{NE}	154

Climb	Full Power, Right Rudder, Pitch 5º, Maintain with ASI
Turn	Set on AI (15º), Maintain on TC, Rudder as Required
Descent	Power to 1600 RPM, Trim for 100 kts Approach Descent: Add 1 notch of flaps (90 kts)
Approach Level	Power to 2,000 RPM, Flaps 1 Notch Trim for 90 kts

DAY TWO OUTLINE

1. Questions from Previous Day
2. Straight & Level
3. Level Turns
4. Airspeed Climbs
5. Rate Climbs
6. Precision and Non Precision Descents
7. Climbing & Descending Turns
8. VOR Orientation & Tracking
9. Holds & 5 Ts

Straight-And-Level Flight

Objective: To develop the basic skill and knowledge of altitude instrument flying as they relate to straight-and-level flight.

Description: A standardized system by which the pitch, bank and power control instruments are integrated to maintain desired altitude, heading, and airspeed.

Altimeter is **PRIMARY FOR PITCH** during Level flight

Execution:

At a constant airspeed, there is only one specific pitch attitude for level flight. At slow cruise speeds, the level-flight attitude is nose-high; at fast cruise speeds, the level-flight attitude is nose-low. The pitch instruments are the attitude indicator, the altimeter, the vertical speed indicator, and the airspeed indicator. The attitude indicator gives you a **direct indication** of pitch attitude. However, unless the airspeed is constant, and until you have established and identified the level-flight attitude for that airspeed, you have no way of knowing whether level flight as indicated on the attitude indicator, is resulting in level airspeed indicator. If the miniature aircraft of the attitude indicator is properly adjusted on the ground before takeoff, it will show approximately level flight at a normal cruise speed when you complete your level-off from a climb. If further adjustment of the miniature aircraft is necessary, the other pitch instruments must be used to maintain level flight while the adjustment is made. In practicing pitch control for level flight using only the attitude indicator, restrict the displacement of the horizon bar to a bar width up or down, a half-bar width, then a one-and-one-half bar width. Pitch attitude changes for corrections to level flight by reference to instruments are much smaller than those commonly used for visual flight. With the airplane correctly trimmed for level flight, the elevator displacement and the **control pressures** necessary to effect these standard pitch changes are usually very slight. A tight grip on the controls makes it difficult to feel control pressure changes. Relaxing and learning to control with your eyes and your head instead of your muscles usually takes considerable conscious effort during the early stages of instrument training. Make smooth and small pitch changes with a positive pressure. Practice these small corrections until you can make pitch corrections up or down, freezing the one-half, full, and one-and-one-half bar widths on the attitude indicator. With the airplane properly trimmed for level flight, momentarily release all of your pressure on the elevator control when you become aware of tenseness. It will maintain level flight if you leave it alone. At constant power, any deviation from level flight must be the result of a pitch change. Therefore, the altimeter gives an **indirect indication** of the pitch attitude in level flight, assuming constant power. Since the altitude should remain constant when the airplane is in level flight, any deviation from the desired altitude signals the need for a pitch change. If the altimeter needle moves rapidly clockwise, assume a considerable nose-high deviation from level-flight attitude. Conversely, if the needle moves slowly counterclockwise to indicate a slightly nose-low attitude, assume that the pitch correction necessary to regain the desired altitude is small. As you add the altimeter to the attitude indicator in your cross-check, you will learn to recognize the rate of movement of the altimeter needle for a given pitch change as shown on the attitude indicator. When a pitch error is detected, corrective action should be taken promptly, but with light control pressures and two distinct changes of attitude: (1) a change of attitude to stop the needle movement, and (2) a change of attitude to return to the desired altitude. As a rule of thumb, for errors of less than 100 feet, use a half-bar-width correction. For errors in excess of 100 feet, use an initial full-bar-width correction.
Remember: Instrument flying is a constant series of small corrections.

PTS STANDARDS
Straight-and-level flight in the aircraft Heading within 10°, altitude within 100 feet, and airspeed within 10 knots Proper instrument cross-check and interpretation, and application of the appropriate pitch, bank, power, and trim corrections

Level Turns:

Objective: To develop the basic skill and knowledge of altitude instrument flying as they relate to standard rate turns

Description: A standardized process by which a standard rate turn is accomplished to the desired heading while maintaining altitude

Attitude Indicator is primary for bank initially. When desired bank is established, the **Turn Coordinator** becomes primary for bank to establish and continue the standard rate turn

Execution:

Set the approximate bank for standard rate on the attitude indicator, which will be about 15°. Once this is established, put the wing of the airplane on the Turn Coordinator and keep it there throughout the turn. Maintain a cross reference to the Attitude Indicator and Altimeter to maintain altitude throughout the turn.

PTS STANDARDS
Maintain standard rate throughout turns Heading within 10°, altitude within 100 feet, and airspeed within 10 knots Proper instrument cross-check and interpretation, and application of the appropriate pitch, bank, power, and trim corrections

Constant Airspeed Climbs and Descents:

Objective: To develop adequate skill and knowledge of the elements related to basic instrument flying during constant airspeed climbs and descents.

Description:

Pitch	The primary instrument is the Airspeed Indicator
Bank (straight)	The primary instrument is the or DG
Bank (turn)	The primary instrument is the T.C.
Power	The primary instrument is the MP

Airspeed Indicator is **PRIMARY FOR PITCH** during airspeed Climbs and Descents

Execution:
To enter a constant-airspeed climb from cruising airspeed, raise the miniature aircraft to the approximate nose-high indication for the predetermined climb speed. Apply light back-elevator pressure to initiate and maintain the climb attitude. The pressures will vary as the airplane decelerates. Power may be advanced to the climb power setting simultaneously with the pitch change, or after the pitch change is established and the airspeed approaches climb speed. Once the airplane stabilizes at a constant airspeed and attitude, the airspeed indicator is primary for pitch and the heading indicator remains primary for bank. If the climb attitude is correct for the power setting selected, the airspeed will stabilize at the desired speed. If the airspeed is low or high, make an appropriate small pitch correction. To enter a constant airspeed climb, first complete the airspeed reduction from cruise airspeed to climb speed in straight-and-level flight. The climb entry is then identical to entry from cruising airspeed, except that power must be increased simultaneously to the climb setting as the pitch attitude is increased. Climb entries on partial panel are more easily and accurately controlled if you enter the maneuver from climbing speed.

PTS STANDARDS
Climbs and descents at a constant airspeed between specific altitudes in straight or turning flight
Constant airspeed climbs and descents from a specified altitude, airspeed, and heading
Maintain the airspeed within 10 knots, heading within 10° or, if in a turning maneuver, within 5° of the specified bank angle
Level-off within 100 feet of the specified altitude
Proper instrument cross-check and interpretation

Rate Climbs and Descents: (Precision and Non Precision Descents)

Objective: To achieve the skill and knowledge of the elements related to basic attitude instrument flying while performing constant rate climbs and descents.

Description:

Pitch	The primary instrument is the vertical speed indicator, (VSI)
Bank (straight)	The primary instrument is the DG
Bank (turn)	The primary instrument is the T.C.
Power	The primary instrument is the airspeed indicator.

VSI at the desired rate is **PRIMARY FOR PITCH** during rate Climbs and Descents

Execution:
The technique for entering a constant rate climb is very similar to that used for entry to a constant airspeed climb from climb airspeed. As the power is increased to the approximate setting for the desired rate, simultaneously raise the miniature aircraft to the climbing attitude for

the desired airspeed and rate of climb. As the power is increased, the airspeed indicator is primary for pitch control until the vertical speed approaches the desired value. As the vertical-speed needle stabilizes, it becomes primary for pitch control and the airspeed indicator becomes primary for power control. Pitch and power corrections must be promptly and closely coordinated. If the vertical speed is correct, but the airspeed is low, add power. As the power is increased, the miniature aircraft must be lowered slightly to maintain constant vertical speed. If the vertical speed is high and the airspeed is low, lower the miniature aircraft slightly and note the increase in airspeed to determine whether or not a power change is also necessary.

Turning Climbs and Descents

Practice the same techniques employed above for climbs and descents while maintaining a standard rate turn

Vertical S Drill if student is ready for this level

PTS STANDARDS
Climbs and descents at a constant rate between specific altitudes in straight or turning flight
Enter rate climbs and descents from a specified altitude, airspeed, and heading
Establish the appropriate change of pitch, bank, and power to establish the specified rate of climb or descent
Maintain the specified rate of climb and descent within 100 feet per minute, airspeed within 10 knots, heading within 10°, or if in a turning maneuver, within 5° of the specified bank angle
Level-off with 100 feet of the specified altitude
Proper instrument cross-check and interpretation

Change of Airspeed

Objective: To achieve adequate knowledge of the elements relating to basic attitude instrument flying during changes of airspeed in straight-and-level flight and in turns.

Description: For changes in airspeed pitch, bank, and power must be coordinated in order to maintain the desired altitude, heading, or bank. When MP is changed to vary airspeed, the airplane tends to change attitude around all axes of movement. Therefore, you will need to adjust control pressures in proportion to the change in MP.

Execution:

Practice of airspeed changes in straight-and-level flight provides an excellent means of developing increased proficiency in all three basic instrument skills, and brings out some common errors to be expected during training in straight-and-level flight. You can increase your proficiency in cross-check and control by practicing speed changes while extending or retracting

the flaps and landing gear. Sudden an exaggerated attitude changes may be necessary in order to maintain straight-and-level flight as the landing gear is extended and the flaps are lowered in some airplanes. Control technique varies according to the lift and drag characteristics of each airplane. Accordingly, knowledge of the power settings and trim changes associated with different combinations of airspeed, gear and flap configurations will reduce your instrument cross-check and interpretation problems.

PTS STANDARDS
Adequate knowledge of the elements relating to attitude instrument flying during change of airspeeds in straight-and-level flight and in turns Proper power setting when changing airspeed Maintaining heading within 10°, angle of bank within 5° when turning, altitude within 100 feet, and airspeed within 10 knots Proper instrument cross-check and interpretation

VOR Orientation and Tracking

Function of VOR

The VOR does not account for the aircraft heading, it only relays the aircraft direction from the station and will have the same indications regardless of which way the nose is pointing. Tune the VOR receiver to the appropriate frequency of the selected VOR ground station, turn up the audio volume, and identify the station's signal audibly. Then rotate the OBS to center the CDI needle, and read the course under or over the index. If you set the VOR to the reciprocal of your course, the CDI will reflect **reverse sensing.** To avoid this reverse sensing situation, set the VOR to agree with your intended course.

VOR Receiver Accuracy Check

Federal Regulations part 91 provides for certain VOR equipment accuracy checks, and an appropriate endorsement, within 30 days prior to flight under IFR. To comply with this requirement and to ensure satisfactory operation of the airborne system, use the following means for checking VOR receiver accuracy:

1. VOT or a radiated test signal from an appropriately rated radio repair station.
2. Certified checkpoints on the airport surface.
3. Certified airborne checkpoints.

VOR test facility (VOT) transmits a test signal which provides users a convenient means to determine the operational status and accuracy of a VOR receiver while on the ground where a VOT is located. Locations of VOTs are published in the A/FD. To the VOT service, tune in the VOT frequency on the VOR receiver. With the CDI centered, the OBS should read 0° with the TO/FROM indication showing FROM or the OBS should read 180° with the TO/FROM indication showing TO. VOT locations can be found on the airport page of Jeppesen Approach Charts or on the NOS Low Altitude Enroute Charts.

Certified Checkpoints

Airborne and ground checkpoints consist of certified radials that should be received at specific points on the airport surface or over specific landmarks while airborne in the immediate vicinity of the airport. Locations of these checkpoints are published in the A/FD. If a dual system VOR is installed in the aircraft, one system may be checked against the other. Turn both systems to the same VOR ground facility and note the indicated bearing to that station. The maximum permissible variations between the two indicated bearings is 4°. DME makes it possible for pilots to determine an accurate geographic position of the aircraft, including the bearing and distance TO or FROM the station. The aircraft DME transmits interrogating radio frequency (RF) pulses, which area received by the DME antenna at the ground facility. The signal triggers ground receiver equipment to respond back to the interrogating aircraft. The airborne DME equipment measures the elapsed time between the interrogation signal sent by the aircraft and reception of the reply pulses from the ground station. This time measurement is converted into nautical miles (NMs) distance from the station.

Execution

Tracking TO and FROM the Station

To track to the station, rotate the OBS until TO appears, then center the CDI. Fly the course indicated by the index. If the CDI moves off center to the left, follow the needle by correcting course to the left, beginning with a 20° correction. When you are flying the course indicated on the index, a left deflection of the needle indicates a crosswind component from the left. If the amount of correction brings the needle back to center, decrease the left course correction by half. If the CDI moves left or right now, it should do so much slower, and you can make a smaller heading correction for the next iteration. Keeping the CDI centered will take the aircraft to the station. To track to the station, the OBS value at the index is not changed. To home to the station, the CDI needle is periodically centered, and the new course under the index is used for the aircraft heading. To track FROM the station on a VOR radial, you should first orient the aircraft's location with respect to the station and the desired outbound track by centering the CDI needle with a FROM indication. The track is intercepted by either flying over the station or establishing an intercept heading. The magnetic course of the desired radial is entered under the index using the OBS and the intercept heading held until the CDI centers. Then the procedure for tracking to the station is used to fly outbound on the specified radial.

Course Interception

If your desired course is not the one you are flying, you must first orient yourself with respect to the VOR station and the course to be flown, and then establish an intercept heading. The following steps may be used to intercept a predetermined course, either inbound or outbound.

1. Rotate the OBS to the desired radial or inbound course.
2. Turn 45° toward the interception heading.
3. Hold this heading constant until the CDI centers, which indicates the aircraft is on course.
4. Turn to the MH corresponding to the selected course, and follow tracking procedures inbound or outbound.

VOR Operation Errors

Typical errors include:
1. Careless tuning and identification of station.
2. Failure to check receiver for accuracy/sensitivity.
3. Turning in the wrong direction during an orientation. This error is common until you visualize *position* rather than *heading.*
4. Failure to check the ambiguity (TO/FROM) indicator, particularly during course reversals, resulting in reverse sensing and corrections in the wrong direction.
5. Overshooting and undershooting radials on interception problems.
6. Over-controlling corrections during tracking, especially close to the station.
7. Misinterpretation of station passage.
8. Chasing the CDI, resulting in homing instead of tracking. Careless heading control and failure to bracket wind corrections makes this error common.

PTS STANDARDS
Intercept and track navigational systems Tune and identify the navigation facility Intercept the specified radial at a predetermined angle Maintain airspeed within 10 knots, altitude within 100 feet, and headings with 5° Apply proper correction to maintain a radial, allowing no more than three-quarter-scale deflection of the CDI Recognize navigational receiver or facility failure, and when required, report the failure to ATC

Hold Entries:

Tear Drop, Parallel, and Direct hold entries will be practiced and perfected

Critical Methodologies:	Right Hand finger method for hold entry determination 5 T's for correct CDI Interpretation
Practice 5 T's in This Order:	**Turn** to desired heading **Twist** to the inbound course **Time** begins at wings level or TO indication whichever occurs last **Throttle** as required for speed (approach level) **Talk** report inbound (needle comes off the wall)

ATC Holding Instructions

When controllers anticipate a delay at a clearance limit or fix, pilots will usually be issued a holding clearance at least five minutes before the ETA at the clearance limit or fix. If the holding pattern assigned by ATC is depicted on the appropriate aeronautical chart, pilots are expected to hold as published. In this situation, the controller will issue a holding clearance which includes the name of the fix, directs you to hold as published, and includes an expect further clearance (EFC) time. When ATC issues a clearance requiring you to hold at a fix where a holding pattern is not charted, you will be issued complete holding instructions. This information includes the direction from the fix, name of the fix, course, leg length, if appropriate, direction of turns (if left turns are required), and the EFC time. Note that all holding instructions should include an EFC time. If you lose two-way radio communication, the EFC allows you to depart the holding fix at a definite time.

NOTES