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| Student:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Date Completed:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ |
| **Private & Commercial Pilot Flight Training** |
| **Navigation Systems & Radar Services** |
| Objective: |
| To develop smoothness, coordination, orientation, division of attention, and control techniques while executing high performance turns. |

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| Elements: |
| 1. Communication radio tuning and testing. 2. Navigational radio tuning and testing. 3. VOR signals for tracking. 4. VOR determining position fixes. 5. VOR warning alarm flag. 6. VOR’s CDI interpretation. 7. VOR TO-FROM indications 8. VOR receiver accuracy check 9. VOR sensitivity, deflection 10 of center 10. ADF/s bearing pointer interpretation. 11. ADF indications of tracking. 12. ADF determining position fixes 13. ADF failure and test procedures 14. DME accuracy 3% or .5 miles. 15. Transponder check and code policy 16. RNAV / LORAN navigation systems. 17. GPS navigation systems. 18. Radio signals and limitations. 19. Radio facilities and aeronautical charts. 20. Manufacturer’s operating instructions. 21. Airport destination, required data checked. 22. Avionics monitoring essential for safety. |

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| Schedule: | |
| Preflight Discussion | 0:30 |
| Lesson 1: VOR navigation (TO and FROM and intercepting radial inbound and outbound) | 0:50 |
| Lesson 2: VOR navigation (Triangulation for fix location) | 0:50 |
| Lesson 3: VOR navigation (Airway navigation) | 0:50 |
| Lesson 4: GPS navigation | 0:50 |
| Lesson 5: Other systems navigation (ADF, DME, LORAN) if applicable. | 0:50 |
| Postflight Discussion | 0:15 |
| All Times Dependent on Pilot's Ability | |

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| Equipment: | |
| Aircraft | Drawing Surface and Marking Utensil |

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| Instructor's Actions: | Student's Actions: |

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| Private & Commercial Pilot Flight Training |

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| Instructor's Actions: | Student's Actions: |
| **PREFLIGHT:**   * Discuss lesson objective * Discuss common student errors in performing the maneuver. * Discuss the FAA's emphasis on safety including collision avoidance and division of attention.   **INFLIGHT:**   * Demonstrate the maneuver. * Coach student practice. * Evaluate student understanding of maneuver.   **POSTFLIGHT:**   * Critique student performance. * Answer student questions. * Assign homework for next lesson. | **PREFLIGHT**   * Discuss lesson objective. * Listens and takes notes. * Resolves Questions.   **INFLIGHT**   * Reviews maneuvers. * Pays attention and asks questions. * Practices maneuver as directed. * Answers questions posed by instructor.   **POSTFLIGHT**   * Ask pertinent questions. * Answers questions posed by instructor. * Critiques own performance. * Completes assigned homework. |

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| Completion Standards: FAA-H-8081-14AS (Private PTS, VII., B.. 1-8) |
| 1. Exhibits knowledge of the elements related to navigation systems and radar services. |
| 1. Demonstrates the ability to use an airborne electronic navigation system. |
| 1. Locates the airplane's position using the navigation system. |
| 1. Intercepts and tracks a given course, radial or bearing, as appropriate. |
| 1. Recognizes and describes the indication of station passage, if appropriate. |
| 1. Recognizes signal loss and takes appropriate action. |
| 1. Uses proper communication procedures when utilizing radar services. |
| 1. Maintains the appropriate altitude, ±200 feet and headings ±15°. |
| Completion Standards: FAA-H-8081-12B (Commercial PTS, VII., B.. 1-8) |
| 1. Exhibits knowledge of the elements related to navigation systems and radar services. |
| 1. Demonstrates the ability to use an airborne electronic navigation system. |
| 1. Locates the airplane's position using the navigation system. |
| 1. Intercepts and tracks a given course, radial or bearing, as appropriate. |
| 1. Recognizes and describes the indication of station passage, if appropriate. |
| 1. Recognizes signal loss and takes appropriate action. |
| 1. Uses proper communication procedures when utilizing radar services. |
| 1. Maintains the appropriate altitude, ±100 feet and headings ±10°. |

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| Common Errors: |
| 1. Station turning and identification faulty. 2. Misinterpretation of navigational signals. 3. Plotting and determination of fixes faulty (Radial versus bearings confusion) 4. Audio control panel is confusing to pilot. 5. NOTAM’s not checked, stations Out of Service. 6. Checklist and or items bypassed. |

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| References: | |
| FAA-H-8083-25A (Chapter 15) | FAA-S-8081-14AS (Private PTS, VII., B. 1-8) |
|  | FAA-S-8081-12B (Commercial PTS, VII., B. 1-8) |

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| Things to Remember: |
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| Private & Commercial Pilot Flight Training |
| Basic VOR Navigation Narrative: |
| **BASIC VOR NAVIGATION**   * Pick a VOR for use in navigation. * Tune and identify the VOR.   **Tune and identify.** Tune the VOR frequency in the navigation radio. It will be listed on VFR and IFR charts as well as instrument approaches if it is a part of the approach. Identify that you have the correct station and the signal is reliable by listening to the Morse code identifier.  [Aircraft on the 254 radial](http://www.wikihow.com/Image:Vor_701.gif)  **Get the bearing.** Determine which radial you are on by turning the OBS (Omni Bearing Selector) knob until the CDI (Course Deviation Indicator) needle is centered and you have a FROM indication.  Looking at this picture, you can see that the needle is centered and it gives a FROM indication (small white triangle pointing to "FR"), so the aircraft is on the 254 degree radial. It doesn't matter what the heading of the aircraft is, it is located somewhere along a line 254° from the VOR station. In order to fly to the station, you would first twist the OBS knob until the needle is centered and the white triangle points to "TO." Note that this will be 74 degrees, exactly 180° from the current radial. Now turn the aircraft to this new heading and keep the needle centered- this will take you to the VOR station.  **Intercepting a Course Procedure:**  [VFR chart excerpt](http://www.wikihow.com/Image:HGO-V-108_211.JPG)  **Fly the heading of the desired course.** You can find the heading of an airway on either a VFR or IFR chart. Set the course into the OBS and turn the aircraft to fly that heading. Once established on the heading, note the position of the CDI. If it is to the right, your course is to the right. Likewise, if it is left, the course is left. 2  **Intercept the course.** Turn 30 degrees in the direction of the CDI to intercept the course. Although 30° is most common and easy to use, you can use any intercept angle. For instance, if you are far enough from the desired course, it may take more than 30° to intercept the course before reaching your destination. 3  **Track the course.** As the CDI moves close to the center, turn your heading to match the course. Keep the needle centered to stay on course. If it starts drifting left, turn left to get back on course.  Tracking inbound (towards the station) and outbound (away from the station) radials is exactly the same, except you should get a TO indication when flying inbound and a FROM indication when flying outbound on a radial.  4[An intersection displayed on an IFR chart](http://www.wikihow.com/Image:Waric-int-ifr_320.gif)  **Adjust for wind.** If you find yourself blown off course by the wind, intercept the course and use a wind correction angle (WCA) of about ten degrees into the wind. If that is not enough, increase the WCA. If it is too much, decrease the WCA until the CDI centered. Identifying an IntersectionSometimes you may need to identify an intersection of two VOR radials. This may be a point where the airway changes heading, to intercept another airway, a change in minimum altitude for IFR flights, holding point, or a reporting point for ATC. The intersection can be determined by using two VOR radials or sometimes one VOR radial and Distance Measuring Equipment (DME). 1  **Tune and identify both VORs just as before.** Two VOR receivers are best, but you can still identify an intersection with one VOR by switching the frequency and comparing the radials of both VORs. 2  **Set the OBS.** Use the OBS to set the correct radials from each VOR. The radials will be displayed on VFR and IFR charts. On VFR charts, the arrows identifying the intersection point to the VOR, while the arrows on an IFR chart point **from** the VOR toward the intersection. 3  **Wait for both CDI needles to center.** While tracking the course on one VOR, watch the other VOR to see when the CDI centers. When both needles are centered, you are on the intersection. Use DME to eliminate the need for a second VOR. While tracking the VOR radial, use the DME to find your distance from the station. DME distances will be displayed on IFR charts when it can be used to identify an intersection. For example, WARIC intersection is defined by the 238 radial from the VOR and the 21 nm DME fix. Occasionally a localizer may be used in place of the second VOR. The procedure is exactly the same, but note that the localizer will be twice as sensitive as a VOR. |