How to use the course

The course itself is divided into 18 steps, which should be completed in order to get the best experience. Steps can be either Ground School or an FSX Mission.

For steps that involve a mission, open FSX and navigate to the MISSIONS section. Full details and charts of each mission are included in the associated pre-flight briefing, which are to be read before each flight.

Please refer to the manual for operating instructions, including setting up FSX for these missions.

[Click Here to Open the Manual]

[Click here to Open the Charts Pack]

Let's get started...
STEP 1

WHY FLY IFR?

Before we get started on learning how to fly on instruments, let’s discuss why we might need to do this.

On a day with clear weather, flying an aeroplane by looking out of the window is simple. You can depart, fly down the coast, turn overhead your friend’s house and stop off somewhere for a burger, all by looking outside.

An instrument rating might seem pretty irrelevant, until you see the clouds rolling in.

It doesn’t take much for the weather to be below the regulatory limits for visual flying. A cloudy day can keep you grounded very easily. You either sit on the ground hoping for improvement, or you fly under Instrument Flight Rules (IFR). To fly IFR, you need an instrument rating.

Airlines will file their flights as IFR as a bit of rain shouldn’t keep a jet full of passengers grounded. If you’re aiming for the airline world, an Instrument Rating will be essential. This course is intended to help you on your way.
It only takes a quick look at some optical illusions to remind you that our human brains can easily be misled. There are a whole range of physical sensations and visual illusions that can lead you towards danger, so let’s have a look at some of them that can give you trouble when flying.

The illusions we have just seen can be very convincing. They have caused many accidents over the years, so we study them so we are prepared to defend against them.

Illusions can come and go as your flying career progresses. For example a new pilot may not have the idea of a ‘standard’ runway yet, so might not get misled by a narrow runway, whereas a grey-haired experienced captain might get caught out late at night on the fourth flight of the day.

Our balance sensors are located in the depths of our inner ears. They usually serve us well, but can be led astray without notice. As we saw when discussing ‘The Leans’, the fluid in our ears initially sense the turn as the motion induces a current in the fluid. But eventually the fluid has accelerated to full speed, and accelerates no more, meaning there is nothing to detect by the tiny hairs that lay in the stream. Once the turn finishes, the fluid is decelerated back the other way, again inducing a current in the fluid. So now you have stopped turning, but your ear senses a strong turn, confusing you into a dangerous predicament.
STEP 3  RULES OF THUMB

Flying can get complicated. To help you ease the load, there are a range of helpful quick calculations to help you out. Let’s have a look at the ones you can use on a daily basis.

DISTANCE TO HEIGHT  DISTANCE x3

This is probably our most used rule of thumb when instrument flying. It works for long ranges, such as when to begin a descent from cruise altitude, or to check your progress as you near the beacon.

In light aircraft then this rule is basically all you need. For larger aircraft with higher inertia, you also have to account for the distance it will take to reduce speed. In most practical terms this means ‘adding a bit’, such as 5-10nm, to your distance.

3 DEGREE DESCENT  GROUNDSPEED x5

Easily worked out and highly useful, the Groundspeed x5 rule also works at long or short ranges. If we had a strong tailwind on approach and did not adjust for it, we would be covering ground more quickly, so our rate of descent would still take us down the glideslope in the same amount of TIME, but as we have travelled further in that time, we might have overshot the airport! Basing our rule on grounds speed solves this problem and takes account of any head or tailwind.

RATE 1 TURN  10% AIRSPEED + 7

With a small aircraft like the Cessna 172, you will be flying pretty much everywhere at almost the same speed, typically 100 knots or so. Once you work out that 17 degrees of bank gives a rate 1 turn, you will use this number over and over. Also you are assisted by the turn co-ordinator, which indicates rate 1 turns when a wing is touching a ‘block’ on the dial.

For larger aircraft, which have no turn co-ordinators and go through significant speed changes throughout a flight, you will be calculating for a few different speeds. If your answer comes up at more than 25 degrees of bank, disregard your calculation and just use 25 degrees, as this is considered the maximum bank angle for flying procedures. In the cruise, rate 1 turns are a little excessive for passenger comfort, so make your turns earlier and with more like 10 degrees bank when cruising in an airliner.
TURN ANTICIPATION  1% GROUNDSPEED

Most useful when a large turn is required, using 1% of your groundspeed is best suited with medium-large aircraft. Throughout the missions you will fly, try to calculate when to turn, but remember that this will be very conservative in the little Cessna unless a very large change of direction is required.

LEVEL OFF  10% VERTICAL SPEED

Mostly of assistance in smaller aircraft, using 10% of your vertical speed can give you a smooth, controlled and comfortable level off. Airliners typically use Flight Directors on their instruments to guide you even more gently, but this feature is usually not found on smaller aircraft.

Be aware that ICAO stipulate some restrictions on vertical speed. In European airspace, if there is traffic nearby as you reach your desired altitude, they impose a limit of 1500fpm for the last 1000ft of climb. The UK have slightly different rules, where you are to reduce your vertical speed to 1500fpm earlier, for the last 1500ft of climb. They also impose a minimum rate of 500fpm in controlled airspace. The FAA impose different rules again, so for maximum realism, look into the restrictions in place for where you intend to fly.

There are more of these quick calculations out there, but we are covering the important ones for our purposes. They all get easier with practice.
STEP 4

MISSION 1 - BASIC IMC

- Takeoff from RWY 26
- Climb to 2000ft
- Level turn to the Right
- Climb on HDG to 3000ft
- Speed changes
- Descending turn
- Rate 1 turn

The first FSX Mission of the course, open FSX, navigate to the missions section and in the “FS Academy – On Instruments” category, open the “FS Academy 1 – Basic IMC” Mission. Read the pre-flight briefing before you start the flight.
STEP 5  NAVAIDS

The highways in the sky are marked out by radio beacons. Understanding the basics of how they work and learning how to use them will be an important step forwards.

As you can see, the Navaids themselves are not particularly complex. We have the benefit of decades of development and improvement of instrumentation and reliability.

It is important to remember the sequence of events to Tune, Identify and Display your navigation aids, as a mistake here will send you off the rails and into a very confusing and dangerous situation.

Now we know what there are and how they work, we need to learn what to do with them.
STEP 6  RADIO NAVIGATION

Our instrument flying will usually take us to, from and overhead Nav aids. Let’s learn how to do this easily, accurately and reliably.

As with any step in the course, if something does not ‘click’ then you should try to work it out clearly in your mind before we progress. Using Nav aids is often a sticking points with new students, so there are many resources available to assist with this crucial step.

We will be putting what we’ve learned into practice in Step 7, so move forwards when you feel ready.
ICAO vs FAA Regulations

This course was built to be as realistic as possible. The regulations we will introduce to you are those as established by The International Civil Aviation Organisation (ICAO), but pilots should note that aviation regulations vary from country to country.

When flying in the United States, the local authority, called the Federal Aviation Authority (FAA) enforces many differences from the standard ICAO regulations.

Some of the main differences are listed below, mainly for use by pilots flying within the USA, to assist with maximum authenticity. A sample of these differences are shown below. They won’t be a factor for our course, but are included as some pilots may find them useful:

<table>
<thead>
<tr>
<th>ICAO</th>
<th>FAA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hold Timing</td>
<td>Outbound Leg</td>
</tr>
<tr>
<td></td>
<td>Inbound Leg (used in Honeywell FMCs)</td>
</tr>
<tr>
<td>Holding Speed Limit</td>
<td>At/Below FL140: 230. &gt;FL140: 240</td>
</tr>
<tr>
<td></td>
<td>At/Below FL140: 230. &gt;FL140: 265</td>
</tr>
<tr>
<td>Line Up Distance</td>
<td>Considered for Takeoff Distance</td>
</tr>
<tr>
<td></td>
<td>Not considered</td>
</tr>
<tr>
<td>Vertical Speed</td>
<td>1000fpm if traffic above/below</td>
</tr>
<tr>
<td></td>
<td>Minimum 1000fpm</td>
</tr>
<tr>
<td>VOR Check</td>
<td>Covered by maintenance</td>
</tr>
<tr>
<td></td>
<td>Required every 30 days</td>
</tr>
<tr>
<td>Holding Fuel Burn</td>
<td>At holding speed</td>
</tr>
<tr>
<td></td>
<td>At cruise speed</td>
</tr>
<tr>
<td>Taxi Across Runway</td>
<td>Must be clearly stated by ATC</td>
</tr>
<tr>
<td></td>
<td>Implied</td>
</tr>
</tbody>
</table>

STEP 7 MISSION 2 – RADIO NAVIGATION

- Takeoff
- NDB: Find your radial, track to station and leave on radial 090
- VOR: Find your radial, track to station and leave on radial 180

Open FSX, navigate to the missions section and in the “FS Academy – On Instruments” category, open the “FS Academy 2 – Radio Navigation” Mission. Read the pre-flight briefing before you start the flight.
STEP 8

DEPARTURE

Now we know how to get to where we need to go, let’s get airborne.

Any IFR flight will, of course, begin with a departure. These procedures are standardised so that everyone follows a route from a set number of agreed routings. This has many benefits such as reliable noise reduction for the surrounding areas and greatly simplifying ATC instructions. Instead of ATC requesting that you “Maintain runway HDG until 2 DME, then turn right track 268, crossing DME 10 at 3000ft or above.....” and so on, they can say “Pole Hill 2X” and we all know what it means.

Our charts are in basically the same format as any other. They all follow roughly the same layout, as they are all communicating the same information. Whether printed on paper or displayed on a tablet computer, charts are always to be kept close to hand for quick reference while flying.

The charts used in this course are included in the ‘Charts Pack’ for printing, but remember you can access them in-flight by using the FSX Kneeboard, as explained in the manual.
STEP 9  MISSION 3 – DEPARTURE

Duration: 15 minutes
Aircraft: Cessna 172
Location: EGNM – Leeds, UK
Objectives: Instrument Departure

- Depart RWY 14
- Fly the POL 2X SID

Open FSX, navigate to the missions section and in the “FS Academy – On Instruments” category, open the “FS Academy 3 – Departure” Mission. Read the pre-flight briefing before you start the flight.
STEP 10  HOLDING

ATC issue ‘Slots’ which are assigned take-off times to help to reduce delays inflight. However, they cannot be avoided completely and there are many reasons why we may encounter delays while already in the air.

Few concepts cause as much confusion for students undertaking their Instrument Rating as hold entries. But it does not need to be so.

There are a handful of ‘Magic’ techniques for visualising a hold in order to see which direction you are approaching it. The technique suggested in this course is the preferred method of many, but of course if it does not ‘click’ with you, then there are alternatives, which can be found online almost instantly.

Once you have the hang of it, it can become strangely satisfying to have conquered this essential skill.

Most holds have right turns. If you encounter one that is to the left, simply mirror the whole picture. Again, this is a crucial step and needs to be understood before progressing further into the course.
STEP 11 MISSION 4 - HOLDING

- Direct Entry
- Teardrop Entry
- Parallel Entry

Open FSX, navigate to the missions section and in the “FS Academy – On Instruments” category, open the “FS Academy 4 – Holding” Mission. Read the pre-flight briefing before you start the flight.

STEP 12 DME ARC

Much like holding, a DME arc can be tricky to grasp at first, but once you have your eureka moment, it becomes simple forever after.

One of the risks to you while you concentrate on maintaining your arc is to lose track of how far you have progressed and keep going around for too long. Remember you are at the tail of the needle.

DME arcs are unlikely to be seen without also being accompanied by a beacon. It is the needle towards this beacon that provides our needle and therefore our guidance around the arc and our bearing. In the Cessna, a VOR is displayed on the OBS, which does not have a ‘needle’ as such, making NDBs considerably easier as they provide an easy to read needle.
STEP 13  MISSION 5 - DME ARCS

- Join a 4 DME Arc Clockwise
- Easy Checkpoints
- Medium Checkpoints
- Complete Arc

Open FSX, navigate to the missions section and in the “FS Academy – On Instruments” category, open the “FS Academy 5 – DME Arcs” Mission. Read the pre-flight briefing before you start the flight.

STEP 14  NON-PRECISION APPROACH

So now that we are well versed in departing, navigating, arcing and holding, it is time to descend and land.

Flying an instrument procedure is essentially the combination of everything we have learned so far. You’ll need your spare capacity to read and the approach charts to understand what is required of you.

It may be helpful to remember that if you can fly the aeroplane on instruments, then all you need to do is the right thing at the right time. They are the combination of speed, altitude and track changes. No NDB approach will require a barrel roll. As you near the runway, you will need to begin configuring your flaps and landing gear in order to perform the landing itself. This varies massively between aircraft and is not the focus of this course. Do remember that as you configure and decelerate, this will have an effect on your glidepath and drift. As you slow, you need to recalculate your rate of descent, which will have reduced slightly. Also your drift will have increased at your new, lower speed, so your wind adjustment will need to be increased as you reduce your pace towards touchdown.
STEP 15

MISSION 6 - NDB APPROACH

- Join EAS Holding Pattern
- Make one lap of the hold
- Leave hold and fly procedure
- Missed Approach

Open FSX, navigate to the missions section and in the “FS Academy – On Instruments” category, open the “FS Academy 6 – NDB Approach” Mission. Read the pre-flight briefing before you start the flight.

STEP 16

ILS

Now we can enter a hold, leave on the procedure and fly down to our minima, let’s change over to an ILS approach. These are used at almost all of the world’s busy airports.

An ILS approach is probably seen as ‘easier’ than an NPA by most students, as it gives clearer indications of how you are doing, without looking into check altitudes etc. The accuracy is also higher when following a Localiser, but care must be taken as the scale displayed on the instrument is much smaller than for a VOR. This means that when intercepting the final approach, a VOR will start to swing into play gradually, giving you a good chance to smoothly turn and intercept. A localiser on the other hand will not start to move the needle until you are very close to the centreline, giving you less time when intercepting. In an airliner this is one of the only times you might use 30 degrees of bank, as a sharper turn is required. To aid in this, if there is another beacon, such as an NDB, at the airport, you can tune it and it will display a rough guide to your intercept, giving you a little more warning.
STEP 17

MISSION 7 – ILS APPROACH

- Depart Runway 02
- Climb out and intercept the procedural approach
- Complete the ILS approach and land on runway 20

Open FSX, navigate to the missions section and in the “FS Academy – On Instruments” category, open the “FS Academy 7 – ILS Approach” Mission. Read the pre-flight briefing before you start the flight.

STEP 18

MISSION 8 – A to B

- Depart Bournemouth runway 08
- Climb out and track to Southampton NDB (EAS)
- Enter the hold at EAS
- Leave the hold and complete the NDB DME approach to runway 20
- Land in Southampton

This is your final mission.
Open FSX, navigate to the missions section and in the “FS Academy – On Instruments” category, open the “FS Academy 8 – A to B” Mission. Read the pre-flight briefing before you start the flight.
MISSION ACCOMPLISHED

...or is it?

Learning to fly on instruments is just the beginning. Now you have the skills, you can fly in almost any weather to almost anywhere. The intention of this course has been to get you flying on instruments like the pros. You know the basics, but only with practice will your flights go more and more smoothly.

Smoothness is key. Procedures are designed to be gentle and as easy as possible. If you find yourself becoming rough with the controls, it is likely that you aren’t thinking far enough ahead. Spare time in the cruise should be used to thoroughly review the charts for what’s coming up next.

Many approaches are tricky, but difficult to notice the sticking points. For example, in a crosswind the aeroplane will be turned into wind slightly, so you may get yourself all the way down the approach to minima, look straight ahead and see nothing, causing a go around. The runway was there to the side, but not where you were looking.

As you progress into faster aircraft, all that you have learned remains true. From our little Cessna to the 747, you will still be using the same rules of thumb and techniques. All that changes is the increased pace and inertia, meaning smoothness is critical in a large aircraft.

I very much hope you have enjoyed this course and that you now feel the door has been opened to an entirely new kind of flying.

Good luck and happy landings.