05-06-2025 - GNav Lecture 5

> Date & Time: 2025-06-05 15:36:25
> Location: [Insert Location]
> [Insert Title]
> `Flight Safety` `Obstacle Clearance` `Radio Communication`

Theme

This lecture covers comprehensive flight planning and safety procedures including calculating minimum safety altitudes, obstacle clearance with additional margins, VFR navigation and diversion strategies, and precise radio transmission fundamentals. It also details regulatory changes, flight log data entry, emergency procedures, and technical aspects of electromagnetic waves essential for aviation training.

Takeaways

1. Minimum safety altitudes and obstacle identification in high sea conditions
2. Calculation of flight altitude adjustments by adding a safety margin (e.g., 1,000 feet) to obstacle heights
3. Distinction between visual flight conditions and loss of ground contact scenarios
4. Discussion of various altitude values including 93, 3,600, 3,700, 6,500, and 7,900 feet
5. Regulatory standards and changes, specifically the UK modifications and the ECOW standard (100 metres clearance requirement)
6. Interactive use of flight planning tools such as the Airmaze app
7. Discussion on the use of the Breezy app for card-based payments
8. Emphasis on precise numerical data and correct chart limitations in flight planning
9. VFR navigation and diversion procedures including the rule to maintain a maximum of 45 degrees deviation when encountering clouds.
10. The importance of proper flight planning using maps and charts, and not relying solely on GPS.

Highlights

- `"Aviate, navigate, communicate."-- [Speaker 4]`
- `"Climb, confess, comply is the golden rule when lost."-- [Speaker 4]`

- `"Just save the password for the future. And don't change it."-- Speaker 4`
- `"I'm not planning to fail."-- Speaker 4`

Chapters & Topics

Minimum Safety Altitude in High Sea Conditions and Obstacle Management

> This knowledge point explains the importance and method of maintaining a minimum safety altitude when flying over the sea, especially when visual contact with the ground is compromised. Detailed numerical references such as 93, 3,600, 3,700, 6,500, and 7,900 feet illustrate the calculations and safety margins required to avoid obstacles during flight.

- **Keypoints**
  - Determining the lowest altitude for safety, e.g., '4 for me, it's 93'
  - Using obstacle data (mountain heights) and adding a safety margin (typically 1,000 feet) to ensure safe flight levels
  - Adjusting flight altitude based on whether the pilot has visual contact with the ground or when flying in high sea conditions
  - Practical examples include maintaining 6,500 feet when necessary, even if satellite readings indicate otherwise
- **Explanation**
  The lecturer discussed that when flying over the sea or in areas where ground contact may be lost, pilots must adhere to a minimum safety altitude. This involves identifying the highest obstacles using precise numeric charts (for example, obstacles marked as 3,600 or 3,700 feet) and then adding a safety margin of 1,000 feet. The explanation also covers what happens in varying scenarios; if the ground is visible, altitude adjustments can be flexible, but in poor conditions, adherence to the minimum safety altitude is critical.
- **Examples**
  > In the scenario involving Santo Domingo, the lecture described that if the highest obstacle is determined (for instance, a mountain height of 3,776 feet indicated by a sequence like 3,7,6), the pilot should add 1,000 feet to set a safe altitude, such as selecting 4,000 feet as the operating altitude in high sea conditions.

  - Identify the highest obstacle value from the provided altitude data.
  - Add the safety margin (1,000 feet) to this obstacle height.
  - Set the flight altitude to the new calculated value to ensure safety, especially under high sea conditions.
- **Considerations**

- Keep all numerical values exactly as provided; do not round or alter values.
- Differentiate clearly between scenarios where visual contact with the ground is maintained versus when it is lost.
- **Special Circumstances**
- If contact with the ground is lost in high sea conditions, immediately climb to the predetermined minimum safety altitude.

Standards and Regulatory Changes for Obstacle Clearance

> This knowledge point covers the regulatory standards affecting obstacle clearance, including a comparison between UK standards and the ECOW standard established in 2009. The focus is on how these standards dictate clearance measurements, such as the stipulation of a 100 metres clearance for obstacles.

- **Keypoints**
  - UK standard modifications that influence minimum rate adjustments
  - ECOW standard, introduced in 2009, requiring a 100 metres clearance when obstacle heights exceed a certain threshold
  - Importance of adhering to documented regulations for safe and legal flight operations
- **Explanation**
  The lecturer highlighted that the regulatory framework for obstacle clearance has undergone significant changes. For example, the UK recently adjusted its standards, and the ECOW standard from 2009 now mandates a 100 metres clearance if an obstacle exceeds the set limit. This discussion underscores the necessity for pilots to stay updated on local regulatory requirements and apply the precise clearance values in their flight planning.
- **Considerations**
- Ensure the correct standard (UK or ECOW) is applied depending on the jurisdiction of the flight operation.
- Maintain exact numerical compliance (e.g., 100 metres clearance) as per the current regulations.
- **Special Circumstances**
- If operating in multiple jurisdictions or under different regulatory standards, confirm and apply the appropriate obstacle clearance requirements.

VFR Navigation and Diversion Procedures

> This knowledge point covers practical navigation, diversion, and host procedures for Visual Flight Rules (VFR) flights. It includes guidelines on maintaining visual separation from clouds, with a maximum deviation of 45 degrees, and emphasizes returning to one’s track after passing obstacles.

- **Keypoints**
  - Ensure visual separation from clouds and precipitation.
  - Maintain the planned track by returning after passing a cloud.
  - Utilize traditional maps and navigational logs for proper flight planning.
- **Explanation**
  The lecture explains that while GPS is available, pilots should rely on maps and charts to plan flights accurately. In VFR conditions, the rule is to deviate a maximum of 45 degrees when a cloud is encountered, then return to the planned course. The instructor emphasized that poor flight planning can lead to significant navigation errors, so it is critical to prepare thoroughly before the flight.
- **Examples**
  > The lecture mentioned Bristol's guideline about a maximum 45 degree deviation when flying VFR and encountering a cloud. It was illustrated by a personal anecdote from the instructor about maintaining visual distance while flying and then returning to the intended course.

  - Used traditional maps to plan the route.
  - Maintained visual separation from clouds according to established protocols.
  - Returned to the correct track after passing the cloud.
- **Considerations**
- Always complete thorough flight planning using maps and charts.
- Do not allow pressure to fly when planning is incomplete.
- **Special Circumstances**
- If there is insufficient time for proper flight planning, the pilot should not commence the flight.

Lost Procedure and Emergency Communication

> This knowledge point details the procedures a pilot should follow when lost in flight. It covers the importance of maintaining calm, checking fuel endurance and time, verifying the last known position, and contacting ATC using the correct emergency channels.

- **Keypoints**
  - Check fuel endurance and note remaining fuel.
  - Recheck the last known position and its corresponding time.
  - Communicate immediately with ATC using the appropriate frequency (121.5 for emergencies).
  - Follow the golden rule: climb, confess, comply.
- **Explanation**
  The instructor stressed the significance of immediate actions when a pilot becomes uncertain of their position. The steps include calming down, performing a detailed

check of fuel, verifying the last confirmed landmarks, and contacting ATC. If the aircraft is equipped with a transponder, using it can help ATC locate the aircraft promptly. These procedures help ensure safety and provide clear guidance during emergencies.

- **Examples**

  > An example was provided where the pilot realizes they are lost, checks the flight log to identify the last known position, notes important parameters such as time and fuel remaining, and then contacts ATC. The use of the emergency frequency 121.5 and the transponder's ident feature was highlighted as a successful method to regain situational awareness.

  - Keep calm and breathe.
  - Verify fuel status and record the time of the last known position.
  - Contact ATC and follow their instructions (such as climbing or descending as necessary).
- **Considerations**
- Maintain constant situational awareness during flight.
- Double-check headings and navigational equipment to prevent misguidance.
- **Special Circumstances**
- If all navigation aids and ground references fail, consider searching for major landmarks like highways that generally lead to cities.

Flight Planning and Error Prevention

> This knowledge point focuses on the critical importance of accurate flight planning. It covers checking the flight log, ensuring that headings, ETAs, and compass synchronizations are correct, and preventing common errors such as transposed numbers in navigational data.

- **Keypoints**
  - Verify all numerical data, such as headings and ETAs, before takeoff.
  - Cross-check the flight log and navigational log to avoid transposing numbers (e.g., 300 vs 330).
  - Ensure the compass is synchronized with the heading indicator.
  - Double-check navigation equipment settings including GPS programming.
- **Explanation**
  The lecture highlighted that gross errors in flight planning can lead to navigation mistakes. Pilots must ensure that all figures in the flight plan are accurate by verifying headings, times, speed, and compass alignment. The instructor stressed that if errors are detected, the flight should be postponed or reviewed thoroughly. Additionally, using secondary equipment such as VOR frequencies can aid in cross-checking the planned route.

- **Examples**
  > An instance was mentioned where a confusion between numbers (like mixing up 300 with 330 or 030 with 010) led to significant navigation errors. The example underscored the need for scrupulous verification of all data in the flight plan.

  - Recheck the flight log for consistency.
  - Confirm that all numbers such as headings and speeds are properly calculated.
  - Use additional navigational aids to verify the planned route.
- **Considerations**
- Always verify navigational numbers from the flight log before heading out.
- Avoid rushing flight planning under pressure.
- Be cautious to prevent misprogramming of navigation equipment.
- **Special Circumstances**
- If errors are identified during the flight planning process, delay the flight until corrections are made to ensure safety.

Flight Planning Input Process

> This knowledge point covers the step-by-step process of inputting flight data into the Platform Creation system (FPM). It includes entering key elements such as flight identification details (flight by, instructor number like 25, and a letter such as alpha), selecting flight rules (VFR training flight), and then moving to aircraft data where one must determine the aircraft type and check registration details.

- **Keypoints**
  - Enter flight number, instructor number (25), and an alphanumeric identifier (e.g., alpha).
  - Select flight rule as VFR for training.
  - Input aircraft data including number of aircraft (1) and type (e.g., cruiser or PS-28).
  - Review aircraft registration documented on paper in the airport.
- **Explanation**
  The instructor demonstrated the process by navigating to Platform Creation > FPM, followed by entering flight-specific information. The importance of accurately recording the aircraft type and registration details was emphasized, along with recalling the proper wake turbulence categories as these figures may appear in examinations.
- **Examples**
  > A sample flight was entered with flight identifier details including flight number, instructor number 25, letter designation alpha, and marked as a VFR training flight. Alongside, the wake turbulence category was detailed with ‘low’ for

> aircraft of 7,000 kilograms or less, ‘medium’ for those between more than 7,000 and less than 136,000 kilograms, and ‘heavy’ for aircraft of 136,000 kilograms or more, with an additional note that ‘J’ occurs every 80.

  - The process starts with selecting the proper platform function and then entering aircraft specifications one field at a time.
  - All numerical values must be entered exactly as provided, ensuring compliance with exam expectations.
- **Considerations**
- Ensure correct numerical values are entered (7,000, 136,000, and 80).
- Double-check the aircraft registration input (e.g., Romeo, Echo, Go) is without dashes.
- Verify that the flight time and departure time are entered with careful attention to local time adjustments.
- **Special Circumstances**
- If the flight schedule appears to conflict with the system’s expected solo time, verify the displayed time with the SIEPA scheduling system.
- If symbols (such as plus signs) are not recognized due to system limitations, double-check the input and use available character substitutes.

Supplementary Data Entry and Equipment Settings

> This knowledge point deals with the entry of supplementary flight data such as equipment details, departure and destination information, and additional student/instructor and operational data into the system.

- **Keypoints**
  - Equipment information must include Sierra Yankee in the first equipment field and Sierra in the last, with confirmation on frequency capability (8.33 kilohertz channel spacing).
  - Departure details include specifying the departure airport (Burgos), scheduled departure time (9 local time with adjustment shown as 0 7 0 0), and entering the next day’s date in the top corner if necessary.
  - Destination is set to Vitoria with an estimated total route time of one hour (even if the flight time is only 40 minutes), and alternate airports such as Logroño or Burgos are specified.
  - Student and instructor data include phone numbers (example: Irish number starting with +353), ID numbers, and emergency radio coding (E-L-T for Personal support, 0 0 2), as well as endurance (five hours and 30).
  - Recording aircraft appearance requires specifying color (white and blue) along with the fly-by logo.

- **Explanation**
  The lecturer walked through the process of entering supplementary information which integrates equipment settings and additional flight details. The adjustment of scheduled departure time to reflect time zone differences and the careful input of alternate route options were highlighted. Special emphasis was placed on ensuring emergency and operational codes are entered correctly to avoid system errors.
- **Examples**
  > After inputting the basic flight plan, users move to enter supplementary data. For instance, the equipment fields are filled with Sierra Yankee and Sierra, a departure airport of Burgos is chosen with an estimated departure set at 9 local time (adjusted using a plus 2 offset, resulting in 0 7 0 0), flight destination Vitoria is recorded with a total estimated route time of one hour, and alternate options like Logroño are provided. Student identification is captured using a phone number starting with +353 and a series of digits (81, 83, 23, 45).

  - The process requires precise numerical input and careful mapping of flight times with scheduling systems like SIEPA.
  - Users are reminded to not alter preset passwords or emergency codes to avoid data misalignment.
- **Considerations**
- Verify departure time conversions (e.g., from 9 local time to the adjusted time 0 7 0 0).
- Ensure that when entering registration details, no symbols are omitted or erroneously added.
- Maintain consistent use of capital letters as the system automatically capitalizes entries.
- **Special Circumstances**
- If the flight scheduling system (SIEPA) displays solo time instead of the total flight time, re-check the input fields carefully.
- In cases where character symbols like the plus sign are problematic, use the system’s recommended input method.

Radio Transmission Fundamentals

> This point explains how radio communication works in an aviation context, detailing the process from the transmission of electromagnetic waves by a tower (as in ATC) to reception in an aircraft. It includes the components of a transmitter, antenna, receiver, amplifier, and the eventual audio output through aviation headsets.

- **Keypoints**
  - A transmitter (e.g., ATC) sends out electromagnetic waves via its antenna.

    - The electromagnetic wave travels at the speed of light (approximately 300,000 km/s).
    - Aircraft are equipped with antennas (or receiver aerials) and receivers to capture and process these signals.
- **Explanation**
  The lecturer described the sequential process where the ATC pushes a button to generate an electromagnetic current, which is then transformed by the antenna into free electromagnetic waves. These waves are picked up by an antenna on the aircraft, processed by a receiver, and finally amplified so that the message can be heard through the headset.
- **Considerations**
- Ensure correct identification of transmitter and receiver roles in avionics.
- Understand the flow of electromagnetic energy from sending to receiving.

Phase Angle Difference in Electromagnetic Waves

> This knowledge point covers the concept of phase angle difference between two electromagnetic (radio) waves, which is pivotal when two transmitters operate simultaneously from the same location.

- **Keypoints**
    - Phase angle difference is defined as the angular difference between the peaks of two waves.
    - An example provided described wave Alpha reaching its maximum at 90 degrees and wave Bravo at 180 degrees, resulting in a 90-degree phase difference.
    - This concept is directly applicable in the functioning of VOR equipment in aviation.
- **Explanation**
  The lecturer explained that a phase angle appears only when two transmitters or antennas transmit simultaneously from the same location. If one transmitter starts even slightly before the other, a phase angle difference is produced. This theory is foundational for understanding the operation of VOR systems used in instrument navigation.
- **Considerations**
- Remember that phase angle requires a comparison between two waves.
- Link the concept to practical applications like the VOR for navigation.

Antenna Types and Their Applications in Aviation

> This point details various types of antennas, their configurations, and applications relevant to aviation, particularly in navigation and radar systems.

- **Keypoints**
  - Loop antennas are used in ADF receivers for directional finding.
  - Dipole antennas consist of two conductive elements and can be oriented horizontally or vertically.
  - Monopole antennas are essentially half of a dipole and transmit directionally in a vertical plane.
  - Parabolic antennas are highly directional and commonly used in radar systems, including weather radar.
  - Slotted planar arrays, noted on F-16 aircraft, are used for weather radar and, if not handled properly, can be dangerous due to high levels of radiation.
- **Explanation**
  The lecturer reviewed several types of antennas by describing their physical characteristics and typical use cases. For example, the parabolic antenna is identified by its parabola shape and is used in environments like airports for radar purposes. The discussion also covered safety concerns, such as the risk of radiation exposure from operating weather radar systems on the ground.
- **Considerations**
- Pay attention to the physical structure and orientation of each antenna type.
- Understand the safety implications, especially with high-radiation radar equipment.

Wavelength Calculation in Radio Communications

> This point covers the mathematical relationship between frequency and wavelength in electromagnetic waves, using the formula $\lambda = c / f$, and explains how to apply it with proper unit conversions.

- **Keypoints**
  - The formula for wavelength is $\lambda = c / f$, where c is the speed of light.
  - For example, using $c = 300 \times 10^6$ meters per second and f = 150 MHz (150×10^6 Hz), the wavelength is calculated to be 2 meters.
  - Understanding the use of prefixes such as ‘mega’ (10^6) and ‘kilo’ (10^3) is essential for accurate calculations.
- **Explanation**
  The lecturer emphasized the process of calculating the wavelength of a radio signal by dividing the speed of light by the frequency. A detailed example was given where a frequency of 150 MHz results in a wavelength of 2 meters. This explanation reinforces the importance of unit consistency and proper conversion using scientific notation.
- **Considerations**
- Ensure all units are correctly converted, especially when dealing with scientific notation.

- Practise the formula to gain fluency in wavelength and frequency calculations.

Modulation Techniques in Electromagnetic Waves

> The lecture explains that modulation is the process of impressing information onto a carrier wave by altering its properties. It detailed the different types of modulation such as amplitude modulation (altering the amplitude), frequency modulation (altering the frequency), phase modulation (changing the phase, useful in satellite navigation), and pulse modulation (used in radar applications).

- **Keypoints**
  - Definition: Modulation is the process of superimposing information onto a carrier wave.
  - Amplitude Modulation: Information is impressed by changing the amplitude of the carrier wave.
  - Frequency Modulation: Information is conveyed by changing the frequency of the carrier wave while keeping the amplitude constant.
  - Phase and Pulse Modulation: Phase modulation for satellite navigation and pulse modulation for radar applications were mentioned.
- **Explanation**
  The instructor compared the process to placing cargo (information) on a boat (carrier wave) and sending it from one point to another. The detailed explanation covered how each modulation method modifies the carrier wave to encode information, emphasizing the importance of understanding these concepts for both practical usage and exam applications.
- **Considerations**
- Memorize the modulation types and their corresponding methods of altering the carrier wave.
- Be aware that different modulation techniques are applied in different phases (phase one vs phase two) of the course.

Frequency Bands and Navigation Equipment

> This section of the lecture detailed the specific frequency ranges associated with various navigation and communication equipment. It mentioned that non-directional beacons (NDB) operate in the low (30 kHz to 300 kHz) and medium frequency (300 kHz to 3 MHz) bands, while VHF-based systems such as the omnidirectional range operate in the 30 MHz to 300 MHz range. Additionally, distance measuring equipment (DME) uses UHF frequencies, and other systems like primary radar and GNSS also operate in UHF and beyond.

- **Keypoints**

- NDB: Operates in low frequency range (30 kHz to 300 kHz) and medium frequency range (300 kHz to 3 MHz).
    - VHF Systems: VHF band is specified as 30 MHz to 300 MHz, used in systems such as omnidirectional range.
    - DME: Operates in the UHF band.
    - Other equipment: Primary radar, DF, and GNSS are mentioned with corresponding UHF (and in some cases ACHF and EHF) frequencies.
- **Explanation**
  The lecturer stressed the importance of remembering the exact numerical ranges for these bands, as questions in the exam may test students on the correct frequency associations with navigational equipment. Practical examples like VOR transmissions were provided, and the instructor even mentioned that there might be mnemonic aids to help remember these frequencies.
- **Considerations**
- Exact numerical values must be preserved and memorized, such as '30 kHz to 300 kHz' for NDB and '30 MHz to 300 MHz' for VHF systems.
- Review all equipment and their corresponding frequency bands routinely to ensure retention for exam purposes.

Radio Wave Propagation and Interference

> This part of the lecture covered how radio waves propagate from the source to the receiver. The main propagation path is via space waves (line of sight), which are limited by factors such as obstacles and the curvature of the earth. At lower frequencies, there can also be surface waves (often termed ground waves) that follow the curvature of the Earth. The lecture further explained phenomena affecting propagation such as side error due to obstacles, propagation (scalloping) error when signals reflect off buildings or terrain, and duct propagation during temperature inversions.

- **Keypoints**
    - Space Wave Propagation: Radio waves travel in a straight line from point to point, but are limited by obstructions and earth curvature.
    - Surface (Ground) Wave: At lower frequencies, radio waves tend to bend around obstacles and follow the Earth's curvature.
    - Propagation Errors: Side error (caused by reflections and obstructions) and duct propagation (caused by temperature inversions) can affect signal clarity and range.
- **Explanation**
  The explanation highlighted that while space wave propagation is common for most radio frequencies, the effective range can sometimes be extended due to surface reflections. The lecturer emphasized that understanding these propagation

characteristics is crucial for navigation and communication, and that environmental effects such as building density or heavy terrain can significantly affect signal reliability. A formula to calculate theoretical range was mentioned, indicating that precise numerical evaluation is possible under specific conditions.

- **Considerations**
- Understand the differences between space waves and surface waves, and when each is likely to occur.
- Recognize the factors that lead to propagation errors, as these can impact both practical navigation and theoretical calculations.

Assignments & Suggestions

- Complete the three lessons mentioned in the lecture and prepare for the exam by reviewing the safety parameters and obstacle charts in detail.
- Practice the interactive flight plan session using the Airmaze app to become familiar with the map and flight chart functionalities.
- Review the regulatory changes discussed, including the UK and ECOW standards, particularly the 100 metres obstacle clearance requirement.
- Review and ensure complete flight planning procedures are followed; recheck headings, times, and navigational data before every flight.
- Prepare a case analysis on the ‘climb, confess, comply’ lost procedure, detailing steps, potential mistakes, and how to communicate effectively with ATC.
- Study the scheduling details for Phase 2 including the KSA exam on July 1st, the end of phase on December 23rd, and the break until January 6th, and prepare a timeline for your flight training.
- Remember to save the password for the website Icaro XX1 for future access and do not change it.
- Review and memorize the wake turbulence categories: low for 7,000 or less, medium for more than 7,000 and less than 136,000, heavy for 136,000 or more, and note the additional ‘J’ category every 80.
- Verify all numerical inputs and flight parameters exactly as demonstrated during the lecture.
- Memorize the specific modulation methods, their principles, and associated frequencies for navigational equipment as detailed in the lecture.
- Review and practice calculations involving the wavelength and frequency formulas using the provided numerical ranges (e.g., 30 kHz to 300 kHz, 30 MHz to 300 MHz).
- Prepare for exam questions by understanding both the theoretical explanations and practical examples of radio wave propagation, including the effects of side error and duct propagation.