



Advect Skills Pvt. Ltd.



DRONE TRAINING SESSION SUMMARY

**SKY SKILLS DRONE ACADEMY
(SSDA)**

ADVECT SKILL PVT. LTD.



➤ Stakeholders & their laws [Basic] Drone Rules 2021:

- To achieve uniformity and agreement between nations in *technical, economics, legal, operational* matters with respect to civil aviation, a **treaty** for establishment of an International Organization, was signed on **December 7th, 1944 at the Chicago Convention**.
- International Civil Aviation Organization or **ICAO**, headquartered at Montreal, Canada, has a council consisting of **36 Contracting States**.
- Three focus areas of ICAO w.r.t RPAS are:
 - **International Instrument Flying Ops,**
 - **Global Interoperability** with regards to Certificate of Airworthiness, Operator Certificate and Remote Pilot License
 - **National Authority Focus:** framework for Domestic operations
- RPASP or **Remote Pilot Aircraft System Panel** was formed by Aircraft Navigation Commission in 2015 as a single-focal point for all UAS-related matters in ICAO.
- RPASP consist of **working group** members from air traffic management, airworthiness, detect and avoid systems, human performance, pilot licensing, RPAS ops, Safety Management, Communication & C2 Link
- **Aircraft Act 1934** is the first law passed in India to regulate the civil aviation industry and make better provision for the control of the manufacturing, possession, use, operation, sale, import and export of aircraft.
- **Aircraft Rules 1937**, under the Aircraft Act 1934, apply to, and to persons on, aircraft registered in India, aircraft operators in India as well as aircrafts for time being in or over Indian airspace.
- The full form of **CAR** is Civil Aviation Requirements.
- CAR is issued by the **Directorate General of Civil Aviation** or **DGCA**
- CAR for RPAS was issued under the provisions of **Rule 15A** and **Rule 133A** of the
 - **Aircraft Rules, 1937.**
- UAS stands for **Unmanned Aircraft System**
- **The Drone Rules** have been notified on **25th Aug, 2021** by **Ministry of Civil Aviation**.
- UAS is **categorized** as **Rotorcraft, Aeroplane & Hybrid**.
- **Classification** of UAS: **Nano, Micro, Small, Medium & Large**



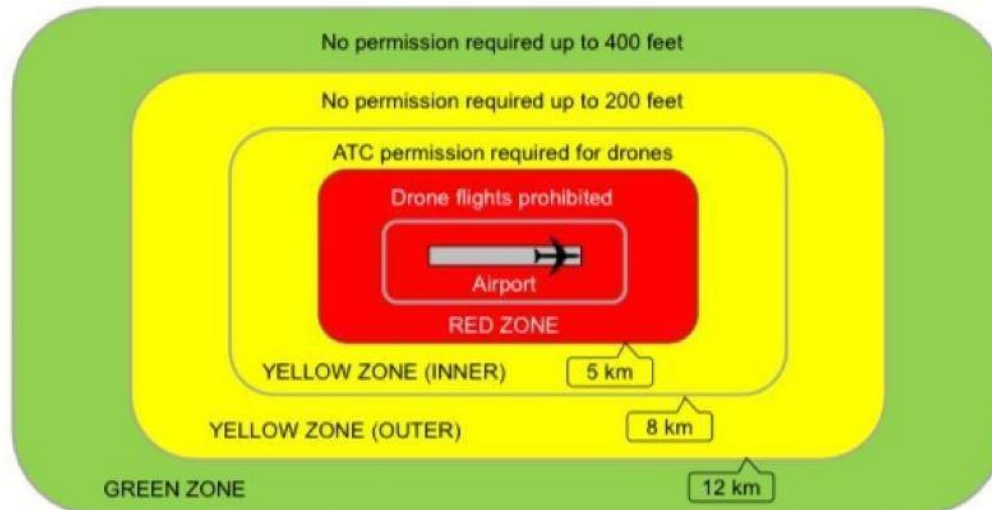
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- DGCA, may, on the recommendation of the **Quality Council of India** or an authorized testing entity, issue a **type certificate** for any particular type of unmanned aircraft system.
- **Import** of unmanned aircraft systems shall be **regulated by the Directorate General of Foreign Trade** or any other entity authorised by the Central Government.
- Each drone would be identified by a **UIN** or a **Unique Identification Number**
- **Digital Sky** is a national **Unmanned Traffic Management (UTM)** platform, designed to automate the entire chain of approvals required to own and operate a drone.
- **Registration, Flight planning and Reporting** are the main features of Digital Sky app.
- The full form of **NPNT** is **No Permission No Take off**.
- For a **Remote Pilot Certificate** issued by **DGCA-authorized RPTO**, an individual should be **Class X** pass from a **recognized board** and minimum **18 years** of age and no more than 65 years of age
- The Indian Airspace is divided **into three zones: Red, Yellow & Green**
- Green Zones are known as Unrestricted Uncontrolled Airspace.



- Flying in “**No Flying Zones**” identified in the Drone Rules 2021 is strictly prohibited
- The fees for UIN, RPL, RPTO shall be paid on Bharatkosh Portal (<https://bharatkosh.gov.in/>)
- The provisions of the Motor Vehicles Act, 1988 (59 of 1988) and rules made there under shall apply, to **third party insurance of UAS** and compensation in case of damage to life and/or property caused by such a UAS



➤ Basic Principles of Flight

- **Aerofoil** is a cross sectional shape of the wing.
- Chord line is the straight line intersecting the Leading & Trailing edges of airfoil.
- **AOA** stands for Angle of Attack.
- Aileron, Elevator and Rudder are the control surface in a fixed wing aircraft.
- Lift, drag and thrust are the forces involved in fixed wing flying.
- **C G** is the point where weight of Aircraft/RPA acts and all Three Axis (Longitudinal, Lateral & Vertical) passes through it.
- Drag on Aircraft/ Drone is caused by friction and differences in air pressure.
- Roll motion of fixed wing is controlled by the movement of Ailerons.
- Yaw motion of a fixed wing UAV is controlled by the movement of Rudder.
- Pitch motion of fixed wing UAV is controlled by the movement of Elevator.
- Weight is the force that tries to pull the aircraft down.
- Thrust is the force that tries to move the aircraft forward.
- Lift is the force that tries to move the aircraft upward.
- Centre of gravity is the point where fixed wing should be balanced about.
- Bernoulli's principle states that an increase in speed of a fluid occurs simultaneously with a decrease in pressure/potential energy of the fluid.
- Newton's 1st Law defines inertia, 2nd Law defines Force $(F) = \text{Mass} \times \text{Acceleration}$ & 3rd Law states "Every action has an equal and opposite Reaction".
- Airfield Traffic Pattern: It is a standard path followed by aircraft when taking off or landing while maintaining visual contact with the airfield.

➤ ATC Procedures & Radio Telephony

- The entire Indian Airspace is owned by Airports Authority of India. It is leased to Indian Airforce (IAF), Indian Navy etc,
- Airspaces are demarcated into Flight Information Regions (FIRs).
- Within FIR's we have Controlled, Uncontrolled areas and Controlled Aerodromes, Restricted, Prohibited or Danger Areas



- Controlled Aerodromes are those Aerodromes that provide Air Traffic Control (ATC) service for arriving and departing flights
- Controlled Airspace are further sub-divided into ATZ – Aerodrome Traffic Zone
- UTC is the time given in aeronautical communications.
- ATC needs to be in regular communication during operation of MALE and HALE.
- All Test flights need to be cleared and approved by ATC prior the operation.
- Any Kind of BVLOS flight operation shall be in continuous monitoring and communication with ATC
- For the Medium and Large category UAVs, Pilot needs a valid Radio Operators Certificate of Proficiency and license by the Central Government.
- The State of Urgency is defined as condition concerning the safety but does not require immediate assistance.
- Distress is the condition that describes the serious and/or imminent danger requiring immediate assistance.
- The phrase to use when you want to say “yes” is AFFIRM.
- The definition of the phrase “STANDBY” is: wait and I will call you.
- CTR is the abbreviation of control zone.
- In order to make a message effective one should speak at a constant volume.
- The term “DISREGARD” means ignore.
- The term “CORRECTION” is used when an error has been made in the transmission.
- The definition of the instruction “MONITOR ...” is: listen out on frequency.
- VFR stands for Visual Flight Rules.
- IFR Stands for Instrument Flight Rules.
- The IFR data shall include mandatory required data like Altitude, Speed, Distance from Home Point, Distance from Waypoint, Fuel Level, Heading.

➤ Fixed Wing Operations and Aerodynamics

- In straight and level powered flight, the principal forces acting on an aircraft are thrust, lift, drag, weight.
- When considering the forces acting on a fixed wing RPAS in straight and level flight at constant airspeed, the weight acts vertically toward the center of the Earth.
- The angle of climb is proportional to the amount by which the thrust exceeds the drag.
- In a climb at a steady speed, the thrust is greater than the aerodynamic drag.



- During a glide the forces acting on an aircraft/ fixed wing RPA are lift, drag, weight.
- If the weight of an aircraft is increased, the maximum gliding range remains the same, but rate of descent increases.
- When gliding into a headwind, the ground distance covered will be less than in still air.
- Skidding outward in a turn is caused by insufficient bank.
- If the angle of attack and other factors remain constant and airspeed is doubled, lift increases by four times.
- By changing the angle of attack of a wing, the pilot can control the airplane's lift, airspeed, and drag.
- The angle of attack of a wing directly controls the distribution of pressures acting on the wing.
- On a wing, the force of lift acts perpendicular to, and the force of drag acts parallel to the flight path.
- Aspect ratio of the wing is defined as the ratio of the wingspan to the average chord.
- The resistance, or skin friction, due to the viscosity of the air as it passes along the surface of a wing is a type of parasite drags.
- Fixed wing drones are the Airplanes which generates lift under the wing due to forward airspeed which is produced by either an internal combustion engine or electric motor mounted with propeller.
- Basic wing types are straight wing, delta wing and swept wings.
- Elliptical wings are more efficient than rectangular and tapered straight wings.
- Horizontal stabilizer houses the elevator and the vertical stabilizer houses rudder.
- Fuels used in engine powered aircrafts would be Glow/ Nitro fuel, Gasoline or Diesel.
- Servo motors are used as actuators to move the control surfaces.
- Fixed wing UAVs are best suited for linear inspection applications.
- Instrument Flying includes flying with the help of instruments providing various parameters such as altitude, air speed, ground speed, wind speed, vertical speed, attitude, flight modes, distance to home position.
- Autonomous flying through a set of waypoints constituting a flight plan is known as Navigation.



➤ Rotorcraft Operations and Aerodynamics

- A drone is an Aerial/ Ground/ Underwater vehicle without a human pilot on-board.
- UAS consists of drone, GCS and a C2 Link.
- A multicopter has more than two rotors.
- Having a small propeller size is one of the main benefits of a multicopter over Helicopters.
- Multicopter and Hybrid UAVs are both VTOLs.
- Easy Take-off and Landing is the main benefit of Hybrid VTOL over Fixed Wing RPAs.
- Quadcopter consists of 4 Rotors.
- Single rotor drones consist of a Tail rotor.
- The first UAV comes under the category of Balloons.
- Austria was the first country to develop UAVs.
- The first UAVs were developed for the application of warfare.
- VTOL stands for Vertical Take-off and Landing.
- Power module is used to regulate the voltage.
- Quadcopter could be in the configuration of X- Shape, H- Shape or Y- Shape.
- The first camera UAV was used for surveillance.
- Abraham Karem is known as the father of drones.
- Albatross was the name of first enterprise drone.
- The working principle of drones is defined by the Bernoulli's Principle.
- RPM per volt is defined by the KV rating of a Motor.
- ESCs are used for Controlling Motor Speed, Control Motor rotation direction and Dynamic Braking.
- ESC stands for Electronic Speed Controllers.
- C-Rating of the battery pack indicates charging or discharging rate.
- Maximum discharge current of the battery is obtained by: Capacity * C-Rating.
- AHRS stands for Altitude Heading Reference System.
- IMU stands for Inertial Measurement Unit.
- IMU comprises of a Compass, Gyroscope and an Accelerometer.
- Roll control is responsible for left - right movement.
- Pitch control is responsible for front-back movement.
- ADSB stands for Automatic Dependent Surveillance Broadcast.
- Telemetry enables you to connect your drone to a ground station (like your pc/ tablet) by means of wireless connection.



➤ Drone Equipment & Maintenance

- Comprehensive maintenance has to be performed after every 200 flights.
- Inspecting Airframe for cracks, checking motors for debris and obstructions, checking propellers for damage are the part of structural inspection.
- Battery check consists of Inspecting charger for visible damage and battery packs for leakage.
- Before performing any kind of structural checks, the battery packs should be disconnected, and the drone should be powered off.
- Drone maintenance with respect to software/ Firmware includes updating drone firmware and updating control station software.
- With respect to the Airframe maintenance, even the smallest crack can cause critical problems.
- Inspection of motors for debris has to be done after the motor is dis-assembled, and propeller is dislodged.
- During the service of Airframe, remove the drone battery, propellers and detach non fixed components from the frame.
- Propellers should be removed when the drone is powered off, battery is disconnected, and all the motors are shut down completely.
- Getting a drone insurance is essential if you are conducting business with your drone.

➤ Weather & Meteorology

- The boundary between the troposphere and the stratosphere called as Tropopause.
- The earth's atmosphere varies vertically and horizontally in: Pressure, Temperature, Humidity, Density
- The international standard atmosphere (ISA) assumes that the temperature will reduce at a rate of 1.98°C per 1000 feet up to 36 090 feet .
- In the lower part of the stratosphere, the temperature is almost constant.
- The pressure of 1013 hPa is known as standard pressure setting.
- The pressure of the atmosphere decreases at a decreasing rate as the height increases.



- Atmospheric pressure may be defined as the force per unit area exerted by the atmosphere on any surface with which it is in contact.
- Wind direction is always given as the direction from which the wind is blowing
- The aerodrome QFE is the aerodrome barometric pressure.
- Measurement of wind speed and direction is done by Anemometer
- The letters METAR stand for **METeorological Aerodrome Report**.

❖ Risk Assessment & Safety Management

- Emergency Procedure should highlight Potential Incident Symptom/ Warning, Expected Situation, Plausible behavior of RPAS, RPAS Pilot Response, Post-Incident Reporting.
- Emergency occurred due to the GPS failure will result in Navigation issue.
- Fly away emergency which occurs due to GPS and hardware/ software failure is known as straying.
- During GPS fail, the pilot should take manual control to recover the UAV.
- In case of emergency landing, if landing point is not appropriate then the RPA Pilot should switch to manual mode and take control of the RPA.
- Loss of COMM link results in the loss of Telemetry Data.
- In case of loss of COM link, 'Communication failure' warning will occur.
- In case of compass failure, pilot has to take manual control and land the UAV.
- In case of airspace incursion, the crew has to identify the air space user and move away from the same and land the RPA.
- In case of any incidents, an incident reporting form has to be maintained by the FTO/ RPTO and an occurrence report has to be submitted to DGCA.
- Rudder failure can be countered by using the elevator and aileron in combination for achieving turns.
- Most commonly available failsafe features are FS-BATT (Battery failsafe) and FS-COMM (Communication failsafe)



❖ Payloads & its Utilization

- Payload is defined as the extra weight a drone or UAV can carry.
- Higher the power-to-weight ratio of the drone, the greater a payload it can carry.
- Flight time will increase if the size of payload decreases.
- Different types of Cameras/ Sensors can be classified as Payloads
- IMU stands for Inertial Measurement Unit.
- RGB cameras with geo-tagging capabilities are used for various mapping and asset inspection projects.
- Thermal cameras are generally may be used during night-time surveillance operations, Archaeology, Inspection of Power Grid and Astronomy.
- Thermal imaging can penetrate obscurants such as smoke, fog and haze.
- Military unmanned vehicles rely heavily on electro-optical sensor payloads to perform their missions.
- Some high-performance gimbals boast software stabilization, encoded video streams, object tracking, and scene steering.
- LIDAR stands for Light Detection and Ranging.
- LIDAR is used for Remote sensing and predominantly used in Forestry, Agriculture & Corridor Mapping
- Range of LIDAR can be increased by using very short Laser pulses.

❖ Drone Data & Analysis

- Observation provides raw data for interpretation.
- Inference is logical process to make observation and interpretation.
- Situation shows how different objects on site are situated in image.
- Ortho-Photo or Ortho-mosaic photos are ortho Rectified or geometrically corrected.
- Ortho Photos have same lack of distortion as maps.
- 3D point cloud is geometrical representation of thousands or millions of georeferenced points.
- DSM stands for Digital Surface Model
- DSM includes ground surface, man-made objects and vegetation.



- DSM is used for RF planning, landscape modelling, city modelling.
- DTM stands for Digital Terrain Model
- DTM is used for ground rupture modelling, land use studies.
- DEM Stands for Digital Elevation Model
- DEM is used for telecom network modelling, flood modelling.
- 3D textured mesh is the most realistic representation of the real- world.
- 3D point cloud is discrete while 3D mesh is continuous.
- 3D mesh helps in Volume estimation and elevation profiling.
- Multispectral images capture image data within specific wavelength ranges of electro-magnetic spectrum.
- Image enhancement and restoration are used to process degraded images.
- An image is a two-dimensional function where x and y are spatial coordinates.
- Visible red light is used in Vegetation discrimination.
- The colour having largest frequency in visible spectrum is violet.
- Visible blue light is used in water penetration.
- Weather observation and prediction is a major application of Multi spectral imaging.
- The major area of imaging in visual spectrum is in Automated visual inspection.
- Remote sensing is an application of Visible and infrared rays.
- A Point Cloud is a 3D visualization made up of thousands or even millions of georeferenced points.
- Digital Surface Model may be useful for landscape modelling, city modelling, visualization applications and more.
- Drone data such as photograph and videos are used for asset inspection like power distribution towers, wind turbines etc
- Thermal images are best suitable for inspection of solar panels.

***** ALL THE BEST *****