UDAAN

Introduction:

On the occasion of Pryaukti 2019, for the first time ever in Haldia Institute of Technology we are organizing the Event Aeromodelling contest "**Udaan**".

Problem Statement:

The competition requires participants to design and fabricate an RC Aircraft (no ready-made aircraft like RTF, ARF, BNF etc. are permitted) and perform a set of tasks. Propellers, Motors, ESC, Servos, Receiver and Transmitter are allowed as off-the-shelf items.The arena will be an open ground.

There will be two rounds in the competition as follows:

Round 1: Gliding round

Round 2: Low-Pass

1. Gliding round

A good measure of the design of an aircraft is in rate of climb and gliding time. In this round, participants are required to make their aircraft (without payload) to climb for 20 seconds. After this, they need to perform a dead stick flight (throttle=0 or Gliding). The aircraft however can be manoeuvred while it is gliding. The teams will be graded based on the glide time of the aircraft as mentioned below.

τ = Total flight time (powered flight time + glide time) in seconds

τ_{max} = maximum recorded flight time amongst all the participants.

$$\text{Round 1 Score} = \frac{\tau}{\tau_{max}} \times 30$$

1st round is not qualifier round and all the participants will qualify to the second round irrespective of their scores. Winners will be selected after the evaluation of Final scores.

1. Low- Pass Round

In this round the manoeuvring capability of the aircraft and skill of the pilot is tested. Participants need to pass the plane through a rectangular loop placed in the middle of the arena with dimensions 5m × 8m (height × width). {Width same as that of football goal and height is double to that of a football goal post}. Participants will be given a time of 4 minutes the number of times it passes through the loop decides the score.

N = Number of passes through the loop in 4 minutes.

$\mathbf{N}_{max}$ = Maximum recorded passes amongst all the participants.

$$\text{Round 2 Score} = \frac{\mathbf{N}}{\mathbf{N}_{max}} \times 70$$

Final Score = Round 1 Score + Round 2 Score.

If there is a tie, the winner will be decided by a separate round framed by the Judges on the spot. Judges' decisions would be considered final in all cases.

Model Specification:

1. T/W <=0.99 without payload (If excess thrust is measured, it will be neutralized by adding weight below the aircraft at center of gravity)
2. Propeller diameter should not be greater than 13 inches.
3. Total wingspan should be a maximum of 1.5 m.
4. Only electrical motors are allowed. The use of IC engines or any other means of providing thrust is prohibited.
5. Use of gyroscopes (gyros) and programming assistance in receivers is prohibited.

Rules on Team Structure:

1. Maximum of 4 members in a team.
2. Members of a team may be from same college/school or different (School/UG/PG).
3. Any number of teams can participate from one college/school.
4. Professionals are not allowed. Only students can participate.

Rules:

1.Each team would be given one attempt in two attempts in both rounds and the best scoreis considered as per the scoring procedure mentioned above for each round.

2.If the aircraft does not take off in the first attempt during qualifier round due to uncontrollable/ natural causes like sudden gusts of wind etc., they will be given the second attempt then and there itself. This will be applicable only if the cause happens within the first 3 seconds of flight.

3.The timer will start the moment the participating team enters the take-off zone with the aircraft or within 30 seconds of the previous team completing their attempt, whichever is earlier. The participants need to be prepared in time and launch without delay after entering the take-off zone.

General Guidelines for the Competition:

1. The use of 2.4 GHz radio is required for all aircraft competing in the competition. If the participants want to use any other frequency, they will have to inform the organizers in advance.
2. A limited number of 2.4 GHz radios will be available with the organizers for use by the teams. Teams who do not have access to radios can inform the organizers in advance to request use of these radios.
3. Receivers installed in the aircraft must be in 'receiver mode only'.
4. All the systems (Servos, motor, etc.) will be checked by organizers for functionality before the competition. If found not working, teams will be dismissed from the competition.
5. Pilot can position himself at any point in the arena to fly the aircraft during the rounds.
6. In view of stringent safety requirements, if a pilot flies out of the designated flying zone which includes overhead of the event organizing and control section, as mentioned at the venue, he/ she is disqualified and has to immediately turn back and land at any cost.
7. Teams are suggested to carry additional components (motors, batteries, propellers etc.) as needed to avoid last minute surprises at the venue. You will lose time/ attempt if you are not ready at the time of your turn.

8. Metal propellers are not allowed.

9. The models can have powered take-off with a landing gear or can be launched manually
by a person standing at ground level.

10. Aircraft should be built from scratch by the participants of the team and should not be a purchased model.

11. A team member can't be a part of more than one team.

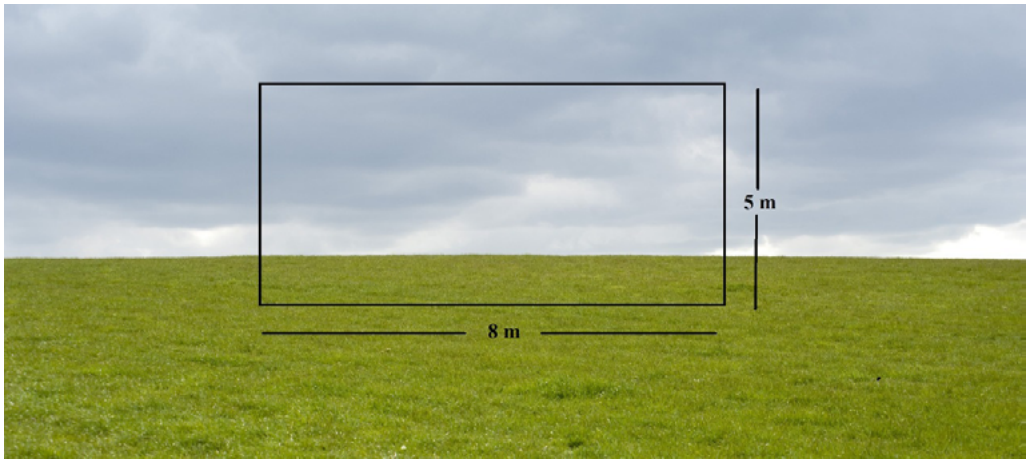
12. Bring your college/student I-Card at the time of competition.

13. Any of the above-mentioned rules, if found violated, teams would not be allowed to participate in the competition.

14. Each team is advised to bring all components for their aicraft although they are coming
from same college. Any delay due to sharing of components might result in your team losing the time available for your attempt or lose the entire attempt itself.

15. Decision Taken by Judges and Organizers will be final and binding for all.

***NOTE: Rules Are tentative at this stage and will be updated in the official website of Pryaukti 2019 when finalized*.**



Udaan

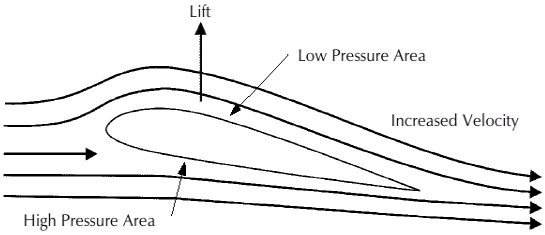
Problem Statement

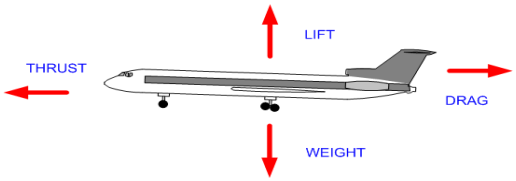
The team has to make an RC controlled fixed-wing plane that can glide on its own as soon as it reaches a certain altitude, by putting throttle stick down. Once qualified for round II, the objective of the team should be to perform Acrobatics with the plane by passing it through a rectangular pole for maximum no. of times within a stipulated time-period. The marking scheme and weightage of each round is discussed in the rules and regulations column of the event section.

Approach

1. Physics of flight

The Aerodynamic lift of plane is explained by Bernoulli's theorem and the equation of continuity. Due to the aerofoil shape of wings, non-uniform displacement of air takes place from its top and bottom leading to a pressure difference and hence creating an upward force named lift.

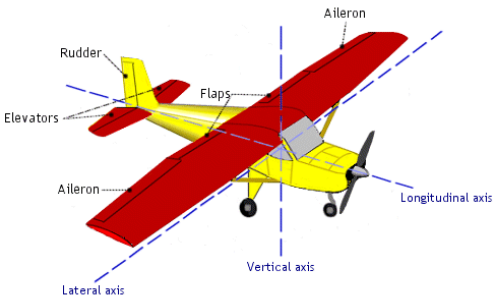


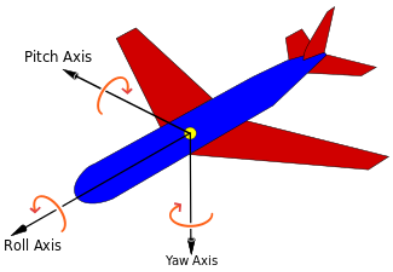


Lift is a counterpart to the weight and thrust is to drag. All these 4 forces act collectively as per newton's law of motion to account for a fixed-wing flight.

2. Control surfaces

The plane can have either 2 or 3 control surfaces depending upon the choice of design. 'Rudder' is responsible for yaw, 'Aerelions' for roll, and 'Elevator' accounts for the pitch rotational motion. The surfaces are controlled by D.C servo motors which works on P.W.M signal sent by the radio transmitter.





3. Plans

Since the requirements from the plane is kept simple, hence it is advised to build a small, light-weight and agile Aeroplane prototype like FT Trainer. Going for larger and complex prototypes like Spitfire or Mini Corsair may lead to drag and control issues. The url for the plan is given below. The wings can also be custom designed by selecting the optimum wing-span to fuselage ratio and maintaining a proper weight by thrust proportion.

FT Trainer- https://s3.amazonaws.com/plans.flitetest.com/stonekap/FT-mini%20Tinytrainer-TILED-PLANS.pdf

N.B: The plan tiles must be printed in the same resolution (100%) on an A4 sheet, or else the measurements may vary.

4. Important Calculations

i) $L = (1/2)\, d\, v^2\, s\, CL$ {source: NASA}

- L = Lift, which must equal the airplane's weight in pounds
- d = density of the air. This will change due to altitude.
- v = velocity of an aircraft expressed in metre per second
- s = the wing area of an aircraft in square metre
- CL = Coefficient of lift , which is determined by the type of airfoil and angle of attack.

ii) Static Thrust

Static Thrust is the thrust value when the plane is assumed to move at a low speed and altitude. Its value vary from the dynamic thrust which gives the actual thrust measure considering all external factors like viscosity of air, pressure gradient at higher levels of stratosphere, power delivered by the source to BLDC motors, etc.
Online thrust calculator: https://rcplanes.online/calc_thrust.htm

Materials Required

1. Plane Model
    - Balsa wood/ Foam/ Sunpack sheet/ Carbon Fiber
    - Spokes
    - Barbeque stick
    - Velcro
    - Elastic Rubbers
    - Wheels (Lightweight plastic)*
    - Suspension (spring)*

For cutting and carving the wings, it is best recommended to use a Thermo foam-cutter as it provides a smooth and uniform surface. Although the same could also be done with paper-cutters but the expertise needed should be high.

(* optional)

2. Avionics
    - BLDC motors (1000-1400 KV rating)
    - ESC (1 Qty, 30C)
    - Li-Po Battery (2200Mah)
    - Propellors (1045)
    - Prop-saver
    - 180° D.C servo motors (4 Qty)
    - Jumpers
    - 2.4 GHz wireless radio Transmitter-Receiver (6 or above channels)

Build and Test

There are some pre-requisites that needs to be followed while building and testing any model plane

- Ensure that there are no gaps, cuts or rough patches on any part of plane or else the effect of drag may get pronounced.
- While binding the receiver with transmitter, always switch on the transmitter first and plug in the battery to UBEC afterwards.
- Always calibrate the ESC & Radio sticks prior to the flight by keeping off the props.
- The Plane should be thrown out of hand at a projectile angle of 45° to get appropriate initial lift

Resources

- https://www.youtube.com/user/flitetest
- http://www.greatplanes.com