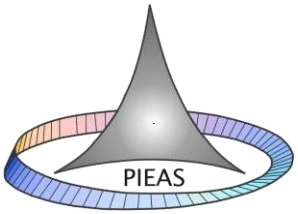

15th Design, Build & Fly Competition 2022

Design and Mission Constraints

Faculty of Mechanical Engineering, GIK Institute

Physical Event

Design Constraints

- The aircraft can be designed in any configuration i.e., tractor, pusher, single motor, twin motor etc.
- The wingspan of the aircraft should not be more than 2.5 meters.
- The weight of the aircraft should be less than or equals 3 kg (for all missions, including payload(s)).
- Lithium Polymer (Li-Po) battery is allowed. The battery should not have a rated capacity of more than 5500 mAh and a rated voltage of more than 12 V.

Mission Constraints

- Aircraft will use ground rolling take-off and landing.
- Missions will simulate take-off from a small austere field.
- The aircraft must take off within 60 ft.
- Aircraft must complete a successful landing at the end of each mission to receive a score.

Mission 1: Without Payload

- Take-off within the prescribed area.
- Perform basic maneuvers:
    1) **Circuit pattern**
    2) **Aileron roll**
    3) **Inside loop**
- All maneuvers to be completed within 5 minutes and only one try is allowed.
- Time starts when the throttle is advanced for the (first) take-off (or attempt).
- Mission performance will be normalized over all teams successfully completing this mission.
- A successful landing is mandatory to get score for the mission.

Mission 2: With Internal Payload

- Payload should be exactly 300 grams in weight.
- The teams can choose the dimensions and material of the payload to suit their design.
- The payload should be a separate entity. It must not be a structural or functional part of the aircraft.
- Take-off within the prescribed area with payload. The payload should be secured in place to ensure that it does not move around during flight.
- Perform maneuvers as:
    1) Two (2) complete **circuit patterns**. (One circuit pattern is one complete round over the main field which is approx. 100 meters).
    2) During the second circuit, the aircraft must perform **inverted fly-pass** through the field once and a **vertical loop** before establishing a final approach for landing.
- All maneuvers to be completed within 7 minutes within which two (2) tries are allowed.
- A successful landing is mandatory to get score for this mission.

Mission 3: Payload Drop Challenge

- The goal of this mission is to drop at least one payload into the specified location on the airfield (see Figure 1).
- There is no constraint on the total number of payloads. A team can include multiple payloads keeping in view the maximum weight constraint.
- The payload should be visible on the aircraft. It must be rigid and a separate entity.
- To maintain a balance in dropping of the payload, the minimum height to drop the payload is 20 feet. The aircraft must be above this height before dropping the payload.
- To determine the minimum height, the teams must use transmitters and receivers with telemetry capability (for example: Turnigy TGY-i6). An on-board height sensor (e.g., Turnigy TGY-CAT 01) can be used to determine the height of the aircraft.
- **A scoring lap is a drop of atleast a single payload within the marked region (touching the boundary would be considered as a score). Score would be multiplied with number of payloads dropped in the marked region.**
- **Only one payload should be dropped in a single lap.**
- Total time allowed for this mission is 7 minutes within which two (2) tries could be performed. **The score for first try would be neglected in case of trying for the second time.**
- Figure 2 below shows the minimum dimensions of the payload. **The shape and material can be selected by the team to suit their design.**
- The maximum weight of a single payload should be 300 grams and accumulated weight should not exceed 2 kilograms of all the payloads.

- The aircraft must complete a successful landing to get the score.

Note: Mission 3 can be performed using manual dropping mechanisms from transmitter or either with automation, which should include the use of different micro controllers e.g., Raspberry pi 2, or Arduino and Pixhawk. The teams using automation for mission 3 will get a multiplier on their score, decided by the judges.

Important Notes: The payload drop-off area is subjected to minor changes. The evaluation criteria is relative and the winner will be declared based on highest number of points. A team may participate in next mission even if it had failed to complete the previous.

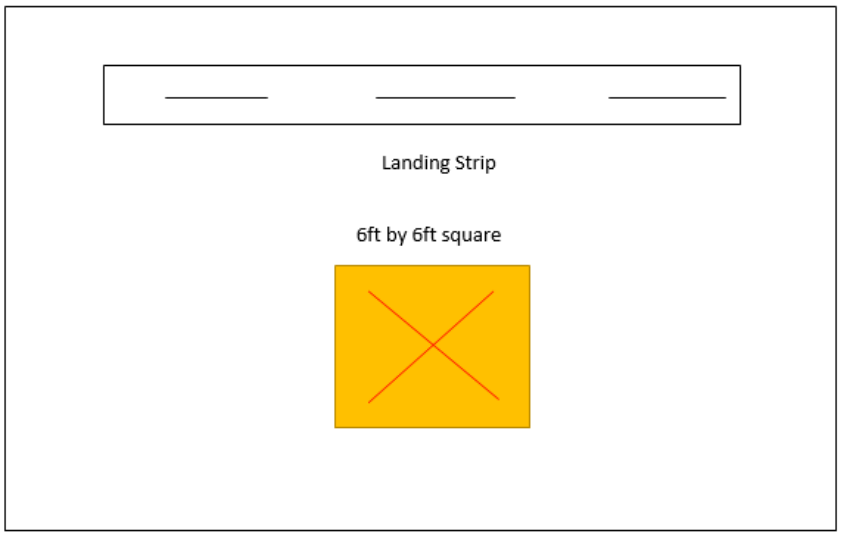

Figure 1 Illustrated Map for Mission 3

Figure 2 Payload Example with Minimum Dimensions

Online Event

Key Changes

- The design constraints will remain the same as mentioned above.
- Mission 1 and 2 will remain the same while the flight for mission 3 is omitted. Scoring for mission 3 would be done on basis of innovation, feasibility and working of dropping mechanism.
- Three videos would be submitted for each of the two missions plus one video elaborating the design aspects of the plane, payload and dropping mechanism (inspection of weight and measurements for wingspan must be included). The extension would be .mp4 or .avi files. The details for mission videos are:

    1) **Flight Cam:** Showing the aircraft from takeoff till landing
    2) **Controller Cam:** Showing the controller for the whole flight
    3) **Cam-views:** showing the view of these previous two cameras at all times.

- All the videos should consist of clear audio, there must be voice over the flight cam conveying about details of the flight (The camera should not loose view of the aircraft). The person must introduce himself/herself first.
- A total of 7 videos must be submitted. The time for mission flight videos (three for each mission) must not exceed 5 min and the end time for all three videos must be similar.
- In mission 2, flight cam must show the separate payload and then its attachment to the aircraft before flight. Additional 2 min in mission 2 are incorporated for this purpose only.
- All the flights must be performed in open grounds. Minimum distance should be taken by the aircraft to take off.
- **Important:** Trimming and editing of video is not allowed. Ambiguity found in any case would result in disqualification of team from the competition.

Technical Report (Format)

Executive Summary

- Summary description of selected design and why it best meets the mission requirements
- Main points from subsequent sections
- Document the performance/capabilities of your system solution

Management Summary

- Describe the organization of the design team
- Chart of design personnel and work distributions
- Milestone chart showing planned and actual timing of major elements

Conceptual Design

- Describes mission requirements (problem statement)
- Translate mission requirements into sub system design requirements
- Review solution concepts/configurations considered
- Describe concept weighting and selection process and results

Preliminary Design

- Describe design/analysis methodology
- Document design/sizing trades
- Describe/document methodology for prediction of aircraft performance (include capabilities and uncertainties)
- Provide estimates of the aircraft lift, drag and stability characteristics and method of prediction
- Provide estimates of the aircraft mission performance

Detailed Design

- Document dimensional parameters of final design
- Document structural characteristics/capabilities of final design
- Document systems and sub-systems selection/integration/architecture
- Document Weight and Balance for final design
- Must include Weight & Balance table empty and with each possible payload/configuration
- Document flight performance parameters for final design
- Document mission performance for final design
- Drawing package:
    1) 3-View drawing with dimensions of all parts
    2) Assembly drawing of aircraft
    3) Exploded view
    4) Payload and dropping mechanism assembly drawings with all dimensions

Manufacturing Plan

- Document the process selected for major component manufacture
- Manufacturing processes investigated and selection process and results
- Manufacturing milestones chart: plan and actual

Testing Plan

- Describe all major ground and flight tests performed.
- Objectives and schedule for each.
- Data to be collected and how applied.
- Test and flight check lists

Performance Results

- Describe the demonstrated performance of key subsystems following execution of testing plan
- Compare to predictions and explain any differences and improvements made
- Describe the demonstrated performance of your complete aircraft solution
- Compare to predictions and explain any differences and improvements made

Bibliography

- List of all published works referenced in the text must be present in this section.
- Any material taken from a published source in all previous sections must have a numerical subscript corresponding to the appropriate citation in this section.
- References should appear in numerical order.
- Format must be APA style.

Contact Details:
Questions regarding the competition, schedules, or rules interpretation may be sent to the competition coordinator by e-mail mentioning team name and personal name. Written reports (only) should be sent at the following postal address:

Dr. Abid Imran
Coordinator Design, Build and Fly Competition (DBFC)
Faculty of Mechanical Engineering, GIK Institute, Topi – 23460 KP. Pakistan
Email: abid.imran@giki.edu.pk
Ext: 2270

For queries:
Muhammad Hashir Rehan
Event Coordinator DBFC
Email: hashir826@gmail.com
Contact: 0341-7841213

Muhammad Hassan Shahid
Event Coordinator DBFC
Contact: 0344-2470724