



# TechTatva '19

---

## Embracing Contraries

# Sky Rush

**MANIPAL INSTITUTE OF TECHNOLOGY**  
NATIONAL AEROMODELLING COMPETITION  
**PROBLEM STATEMENT**



## Contents

<b>1</b>	<b>Overview</b>	<b>1</b>
<b>2</b>	<b>Aircraft Design</b>	<b>1</b>
2.1	Design Constraints . . . . .	1
2.2	Design Report . . . . .	1
<b>3</b>	<b>Technical Inspection</b>	<b>2</b>
<b>4</b>	<b>Flight Rounds</b>	<b>2</b>
4.1	Flight Area . . . . .	2
4.2	General Rules . . . . .	3
4.3	Flight Round 1 . . . . .	3
4.4	Flight Round 2 . . . . .	4
<b>5</b>	<b>Scoring</b>	<b>5</b>
5.1	General . . . . .	5
5.2	Round 1 . . . . .	5
5.3	Round 2 . . . . .	6
<b>6</b>	<b>Frequently Asked Questions</b>	<b>7</b>
<b>7</b>	<b>Contact Details</b>	<b>7</b>

## 1 Overview

The objective of the competition is to design and fabricate a radio controlled aircraft that conforms to the given constraints and is able to accomplish a set of manoeuvres mentioned in the successive sections.

## 2 Aircraft Design

### 2.1 Design Constraints

The aircraft must conform to the design constraints mentioned below. Any case of non-compliance with the design constraints will lead to disqualification of the team.

1. A maximum Thrust-to-Weight ratio of 1.00 for Round-1 and Round-2 (without payload).
2. Total wingspan should not exceed 120 cm.
3. Only electrical motors are allowed. IC engines and other forms of propulsion are prohibited.
4. Gyroscopic assistance is prohibited.
5. The aircraft must be flown using line of sight approach. The use of FPV systems are prohibited.
6. Aircraft must be hand-launched during the flight rounds.
7. Aircraft must be capable of releasing payload mid-flight. Teams are required to bring their own payload. There are no restrictions on the size and weight of the payload.
8. The payload must be released as **one integral unit**.
9. Aircraft must have **removable motor mount** for thrust testing during technical inspection.

### 2.2 Design Report

A design report detailing the design and build process of the aircraft must be drafted along the guidelines mentioned below.

1. The report must contain specifications of the design, 2-D planform, weight build-up and electronics with suitable justification as to why they were chosen.
2. Photographs of the build process should be included.
3. The report must not exceed 10 pages.
4. The design report must be emailed to [skyrush.techtatva19@gmail.com](mailto:skyrush.techtatva19@gmail.com). The subject of the e-mail should be "College Name- Team ID". The deadline for report submission is 1<sup>st</sup> October 2019, 11:59 PM. Submissions after this will not be considered.
5. A hard-copy of the report must be in hand on the day of the competition.

### 3 Technical Inspection

1. All aircrafts will be subjected to a technical inspection before being given flight clearance. The dimensions of the aircraft will be cross-checked with the design report. Any deviations beyond 3% of the listed specifications will be penalized.
2. The thrust-to-weight ratio will be verified using a thrust testing setup (Racestar Brushless Motor Thrust Stand V3). Teams are required to have removable motor mounts for the same. If the ratio limit is exceeded, teams will be given a choice between adding extra weight (at CG) or limiting their transmitter end-points to maintain the required T/W ratio.

### 4 Flight Rounds

#### 4.1 Flight Area



Figure 1: Total Area

The above image details the division of the total area into 3 zones, divided as follows.

1. **Flight Area** - All flight rounds of the competition will be conducted in this zone. It designates the permitted flight airspace.
2. **Set-Up Area** - Teams on standby will be situated in this zone. It contains areas for aircraft repair, setup and other required amenities.
3. **No-Fly Zone** - This zone represents restricted airspace. Teams that exceed the boundaries of the flight zone will be penalized.



## 4.2 General Rules

1. Teams will be notified when it is their turn to attempt a flight round. A 10 minute aircraft setup time will be provided once the announcement has been made. Teams exceeding their allotted setup time will be penalized.
2. Teams are allowed to exchange allotted flight slots at the cost of incurring penalty points.
3. Only the pilot and two members will be allowed in the flying area during the flight rounds.
4. An official will be present with the pilot at all times during a round. In the event of a safety hazard, the official will instruct the pilot to ground the aircraft, following which the pilot must perform a landing immediately. Teams that contradict the official will be disqualified.
5. Two flight rounds will be conducted. Each team will only get a single attempt for each round. The details of the flight rounds are given below.

## 4.3 Flight Round 1

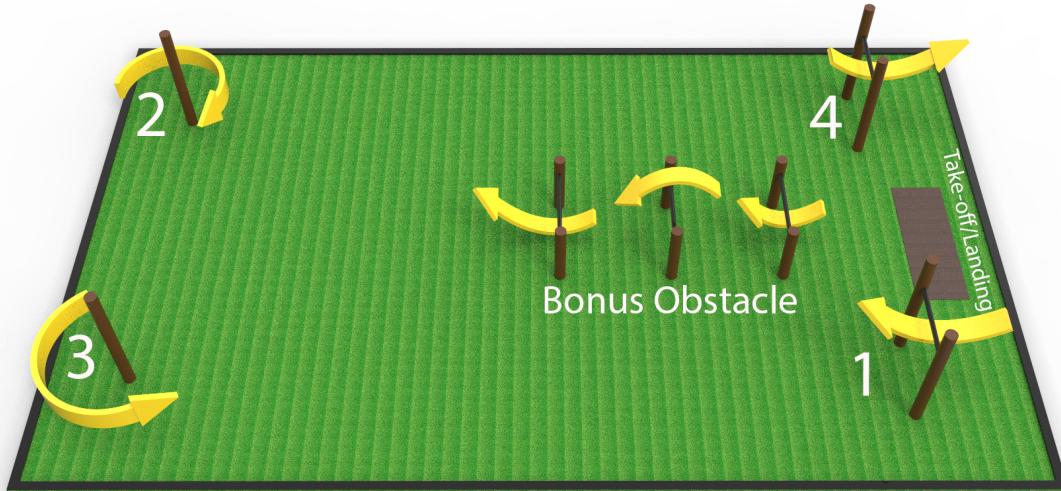


Figure 2: Round 1 Course Outline

1. The maximum flight time allotted for this round is 3 minutes. The timer will start on take-off and the pilot must land before the stipulated time failing which, a penalty will be awarded.
2. The team called to fly will be directed to the Take-off/Landing zone, marked above. The pilot may position himself at his discretion, but the aircraft must be launched from within the Take-off/Landing zone ( $6m \times 4m$ ).
3. The pilot must then fly through a sequence of compulsory obstacles in the specified order, as illustrated. For example, obstacle 2, 3, 4 may not be attempted unless obstacle 1 has been completed. No obstacle can be attempted repeatedly. Points will be allotted for each completed obstacle.



4. The compulsory course may be attempted again on the successful completion of the entire course.
5. Additionally, the pilot may choose to fly through an optional bonus obstacle in the centre for extra points. The bonus obstacle may be attempted only once on each successful completion of the compulsory obstacles.
6. On landing, the aircraft must come to a stop within the landing zone. Failing to do so shall result in a penalty.
7. Once the aircraft is in the air, any return to the ground will be considered the end of the round for the concerned team.

#### 4.4 Flight Round 2

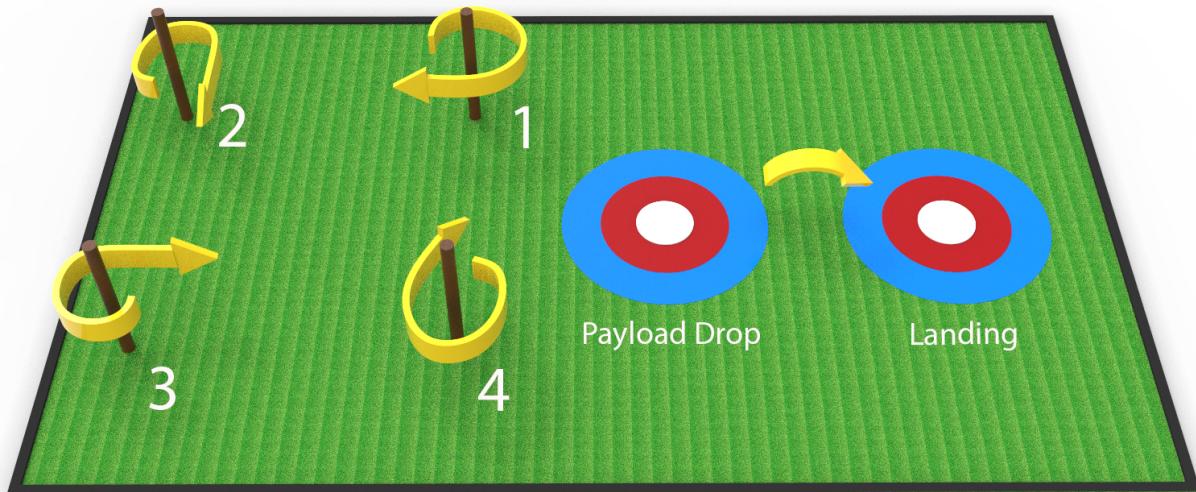


Figure 3: Round 2 Course Outline

1. This round consists of three parts -
  - (a) Gliding
  - (b) Obstacle Course
  - (c) Payload Drop

All three parts must be completed within a single flight while carrying the payload.

2. The round shall begin with 20 seconds of powered flight on completion of which the pilot will be instructed to cut throttle. Failing to do so will result in a penalty.
3. The gliding part of the round shall be followed by an obstacle course. The glide time will end once the pilot applies throttle in order to complete the obstacle course. The pilot must call to the officials before applying throttle again.
4. The obstacle course must be attempted in the order as shown in Figure 3.



5. The obstacle course is followed by a payload drop wherein the pilot must drop the payload being carried in the area marked in Figure 3. Points shall be awarded based on the final position of the payload.
6. On successful completion of all three parts of the round the pilot may land the aircraft in the landing zone. Points for landing will be awarded based on where the aircraft comes to a halt.
7. Contact of the aircraft with the ground at any point in time before the completion of all three parts of this round shall result in the score for Round 2 being reset to zero.

**Note:**

- There are no time restrictions for this round.
- Thrust-to-Weight ratio for this round is 1.00 and shall be considered for the empty weight of the aircraft.

## 5 Scoring

### 5.1 General

1. Dimensional deviations above 3% from the design report, noted during the technical inspection, will be penalized at -2 points per millimeter.
2. Teams that would like to exchange their flight round slots may do so at the cost of 20 points each.
3. Teams that exceed their setup time of 10 minutes will be penalized at -0.2 points per second extended.
4. In the event of any aircraft entering the no-fly-zone, the team's score for that particular round will be invalidated.

### 5.2 Round 1

The round will be scored according to the following equation.

$$Score = 5n + 10m + 30a - Z$$

where,

n = No. of successful attempts around the poles

m = No. of successful limbo attempts

a = No. of successful bonus obstacle attempts

Z = Penalty Points

Violation	Penalty
Exceeding the allotted flight time	2 points per second exceeded
Landing outside the specified zone	15 points

### 5.3 Round 2

The round will be scored according to the following equation:

$$Score = \left( \frac{G^2x + P + L}{2t - 1.9G} \times 50 \times G \times x \right) - Z$$

where,

G = Glide time in seconds

x = Payload fraction

P = Points for the Payload Drop

L = Points for Landing

t = Total Flight Time in seconds

Z = Penalty Points

Violation	Penalty
Dropping payload outside specified zone	5 points
Landing outside the specified zone	5 points
Exceeding the limit of 20 second powered flight	5 points per second

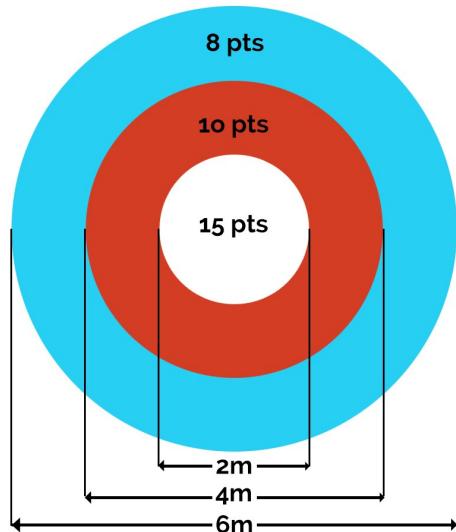


Figure 4: Dimensions and Scoring for Payload Drop and Landing

## 6 Frequently Asked Questions

1. Can the bonus obstacle be attempted multiple times?

The bonus obstacle in Round 1 may be attempted once for every successful completion of the compulsory course.

2. Can the compulsory course in round 1 be attempted multiple times?

Yes. The compulsory course may be attempted multiple times. Bonus obstacle does not need to be attempted in order to attempt the compulsory course again.

3. Do we have to land after gliding in Round 2?

No. Contact with the ground on completion of gliding shall result in the score for Round 2 being reset to 0. The pilot may come as close to the ground as he deems fit in order to maximise his glide time. All three parts of Round 2 must be completed in one single flight.

4. Will points be allotted for completion of the obstacle course (poles) in Round 2?

No points are allotted for the obstacle course in Round 2 however the course must be completed. Failing to do so will result in the score being reset to 0.

5. What constitutes a successful landing?

With the exception of a broken propeller , if any other components fall off during landing, the landing will be considered unsuccessful and will not be awarded any points.

6. What will be considered as the point of payload drop and landing for scoring?

The point where the aircraft and payload come to rest will be considered for scoring. If the aircraft/payload comes to rest between two circles, the lower score will be awarded.

## 7 Contact Details

For any queries regarding the problem statement or the competition, contact:

Arnav Dev: +91-9582980068

Rohin Arte: +91-9741326721

**Note:** In case of any unforeseen circumstances or discrepancies, all decisions taken by the team of SkyRush will be final.