

# Launch Systems 2025-26

## Project assignment

### Option 1 – Launcher for manned capsule

Consider a suborbital launch vehicle with advanced manned troop transportation capacity, made by a launcher (stages to be defined by the team) and a capsule with 6 people on board. After the release, the capsule shall have a ballistic trajectory capable of reaching the “other side of the globe” (say, the exact point with respect to the launch location) with an accuracy of 20 km. Launch site has to be selected and landing site must be on the ground (not sea). The students shall consider:

- The launcher (one or more stages) will be expendable
- The launcher is subject to disturbance of wind and imperfections. Capsule trajectory, guidance, and other details are not the task of the assignment. After the release, assume that the capsule has a perfect ballistic trajectory, disregarding the atmosphere. You have to demonstrate that you can obtain at least 50% of mission success.
- The capsule shall be conceived in terms of shape, size, weight, center of mass. A parachute should be accounted for in terms of size and mass.
- Technology position: high TRL, minor technology developments (AD2 risk rate less than 40%)
- Programmatic requirements: human rated launch, standard personal military equipment shall be considered for mass and size (backpack for exploration mission, 3 days of duration), launch from a spaceport (existing or under consideration).
- Ground rule: (for launcher only) impact on ground shall not harm anyone on ground (casualty risk  $10^{-4}$ ), technology access and launch site should be compatible with geopolitical situation (countries which reasonably can make agreements among them).

### Option 2 – Sounding rocket for plume probing

Consider a sounding rocket (probe) that moves inside the plume of another launcher (after about 10 minutes from the first launch) and, thanks to a small intake placed on the nose, a scientific payload will analyze particulate and chemical composition. The rocket shall follow the trajectory of the past launcher at least up to the upper border of the stratosphere. Then, the scientific payload will be recovered for reuse. An estimation of the landing area shall be given with an accuracy of at least 50% of probability. Do not design the probe, only indicate a proper location for its placement. Assume its size/shape negligible for your aerodynamics.

The students shall consider:

- The launcher (one or more stages) will be expendable
- At least 50% of the flight time must be within 2 km from the launcher trajectory (use a generic trajectory from the literature, at your choice)
- Launcher and parachute recovery are subject to disturbance of wind and imperfections.

- Mass and volume of the scientific payload shall be inferred from the literature
- Technology position: high TRL, minor technology developments (AD2 risk rate less than 40%)
- Programmatic requirements: green propellant, launch area is dedicated and it is at safety distance from the first rocket launchpad.
- Ground rule: (for launcher only) impact on ground shall not harm anyone on ground (casualty risk  $10^{-4}$ )