Project ID + Title 64 – Preliminary design of a cold gas micro-propulsion system for atmospheric drag compensation	**Type** Analysis + Design

Supervisor(s)
A. Cervone

General Background
As discussed in the Micropropulsion course reader, a particularly interesting application of micro-propulsion systems is to counter-act the atmospheric drag generated by small satellites orbiting at very low altitude, allowing for longer mission lifetime.
Although cold gas micro-thrusters are not typically the preferred option for this application, in some cases they can represent a simple and reliable alternative to more complex and power-hungry options, such as electric micro-propulsion.
In this project, you will propose the preliminary design of a cold gas micro-propulsion system intended for compensating the atmospheric drag force generated by a **3U CubeSat** orbiting at **300 km altitude** in Low Earth Orbit, with intended lifetime of **6 months**. You will start by generating the requirements for this specific case, using simplified equations similar to those presented in the course reader to estimate thrust, Delta-V and any other relevant performance parameters. Based on these requirements, you will then design in a preliminary way a complete cold gas micro-propulsion system including all components, in particular: thruster(s), propellant tank(s), feeding system.

Required Input *(to be provided by the supervisor)*
- Simplified design/performance equations and cold gas micro-propulsion information provided in the course reader

Tasks
- Using the simplified equations provided in the course reader, generate a sufficiently detailed list of requirements for the intended atmospheric drag compensation application
- Based on these requirements and on simplified equations (for example, those given by the Ideal Rocket Theory), propose a preliminary design of a cold gas micro-propulsion system. Include in the design all components of the system: the thruster, the tank and the feeding system. For the feeding system, make use of COTS components when possible.

Research Questions
RQ1 – What is a suitable list of requirements for the intended atmospheric drag compensation application?
RQ2 – What is the most promising design for a cold gas micro-propulsion system to meet the given requirements?

Final Deliverables
- Final report describing in detail the outcomes of all project tasks, including in particular a list of propulsion system requirements for the intended application
- Preliminary design and simplified drawings of the cold gas micro-propulsion system

Grading criteria + rubrics

	Fail	*6 (sufficient)*	*7 (satisfactory)*	*8 (good)*	*9 (very good)*	*10 (excellent)*
Understanding & Application of Theory (30%)	Does not understand and can not apply theory to the given project.	Partially understands and applies, only with effort, theory to the given project.	Understands theory and can apply it only after having been shown how to do it.	Understands theory and has independently applied it to the given project.	Has independently collected new theory from additional sources and applied it to the given project.	Has independently developed a new piece of theory and applied it to the given project.
Critical Attitude (20%)	Has no critical attitude towards own design and results.	Has limited critical attitude towards own design and results.	Has sufficient critical attitude towards own design and results.	Has well balanced critical attitude towards own design and results.	Has validated own design and results by comparing them to other independent sources.	A complete and thorough validation of the whole design, process and results has been carried out.
Report and Deliverables (30%)	One or more of the deliverables is missing or has very poor quality.	The report, although fulfilling all basic requirements, is unclear and poorly expressed. Deliverables can not be used for future work.	The report is reasonably expressed and mostly clear. Some of the deliverables can be used for future work.	The report is clear and free of scientific errors. All deliverables can be used for future work.	The report is very good and can be potentially used for future publications. Some deliverables will represent a fundamental input to future work.	The report or part of it will certainly be published. All deliverables will represent a fundamental input to future work.
Creativity and Initiative (10%)	No initiative at all and no attempts to give an original contribution to the project.	Some individual initiative from the student, but still no original contributions to the project.	At least one original contribution to the project, not directly initiated or thought by the supervisors.	More than one original contribution to the project, not directly initiated or thought by the supervisors.	More than one original contribution to the project, not directly initiated or thought by the supervisors, including some improvements in the methodology initially proposed by the supervisors.	Was able to constructively reshape the project with a number of original contributions and an innovative methodology.
Project Management & Planning (10%)	Wasted all the available resources and was not able to conclude the project.	Concluded the project very close to the maximum 3 months allocated to it, with no real reasons for this delay.	Concluded the project in more than 50% additional time than the nominal expected effort (84 hours), requiring significantly more supervision time and resources than expected.	Took slightly more than the nominal expected effort (84 hours) to conclude the project, requiring more supervision time and resources than expected.	Concluded the project within the nominal expected effort (84 hours), but still requiring more supervision time and resources than expected.	Concluded the project within the nominal expected effort (84 hours), and didn't require more supervision time and resources than expected.