# MANNED LEO SPACEPLANE A PRELIMINARY DESIGN APPROACH

## ABSTRACT

The main objective of the present work is to carry out the preliminary design of a reusable manned spacecraft multi-purpose spacecraft with the main objective of being able to serve two separate space stations in low earth orbit during the same mission.

Reaching space and initiating the mission is the primary task of the selected launcher vehicle from a pre-scribed spaceport. Usually, the selection is done based on political criteria, since few countries fulfill international laws concerning the safety of a space launch, rather than the performance of the vehicle

The spaceplane, named "Prometheus," is designed for multiple mission objectives, including servicing space stations in LEO and delivering both cargo and crew. The study examines current LEO spacecraft, such as SpaceX's Crew Dragon and Boeing's Starliner, and proposes improvements in mission flexibility and autonomy. The analysis includes mass estimation for essential subsystems such as propulsion, landing gear, and thermal protection. The propulsion system relies on hypergolic engines, and the thermal protection system ensures safe re-entry. Additionally, the spaceplane is designed to accommodate up to seven crew members, with specific provisions for life support and crew comfort.

The report emphasizes the importance of accurate mass distribution for the spacecraft's structural integrity and mission success, employing advanced computational methods and historical data for optimization. This design contributes to the ongoing advancements in space exploration by offering a more efficient and reusable spacecraft model suitable for future LEO missions.

The process presented is iterative until convergence of results is achieved. The estimation process uses as input an engine's mass ($m_{ENG}$), the propellant's mass ($m_{PROP}$), and the crew mass ($m_{CREW}$). Outputs of the process will be the structural mass ($m_{STR/TPS}$), which includes and the mass for the thermal protective system ($m_{TPS}$), the landing gear mass ($m_{LG}$), the electrical power system mass ($m_{POWER}$), the cargo mass-scientific devices etc.- ($m_{CAR}$), the avionics mass ($m_{AV}$), the environmental control life support system mass ($m_{ECLSS}$) and the mass of secondary equipment ($m_{SEC}$).

## 5 KEY WORDS

1. Electrical System
2. Mass
3. Time
4. Low Earth Orbit
5. Vehicle design