Assignment – Staging

Consider a three-stage launch vehicle that is required to lift a 50 Tons payload to a orbital speed of 7.798 km/s.

For each stage, we are given that:

Stage 1: Isp = 263 s
Stage 2: Isp = 419 s
Stage 3: Isp = 426 s

a) Consider the gravity and drag losses that are likely to occur mostly in the first steps of the trajectory and provide reliable assumptions.

b) Based on the existing launch vehicle mass properties, assume reliable propellants and structural mass fractions and find the optimal mass of the vehicle considering as target DV = DVideal+ Dvlosses.

c) Assume that the first and second stages are completely responsible for dealing with the losses. Compute the staging speed and the “optimal” mass with the robust design methodology, by showing the effects of α and β coefficients.