AAE 412/512 – Space Systems Engineering

Mission Design Project

<u>Due date:</u> 12/7/2021, 2 pm (Finals week)

<u>Submission:</u> Show all work, and submit any code used. On Canvas, please submit a combined PDF of analytical work, code, and results. This assignment should be submitted as a group (three or less) effort; please include a signature cover page where all group members state that they contributed to the work.

Beaver Space Systems (BSS) has been tasked to deliver a space telescope to observe far planets of the solar system and beyond into the galaxy. The following are the mission specifications:

a) The telescope needs to be placed in one of the Lagrange points of Sun – Earth such that light interference from the sun is minimal.

b) The telescope needs to perform a circular orbit around the earth at an altitude of 10,000 km and then placed on an orbit towards the Lagrange point

c) The telescope is designed by an external team and has the required instrumentation to perform orbit transfers.

d) The telescope has a mass of 5000 kg with dimensions of 10 m x 7 m x 5 m (L x W x H).

As a part of the **BSS** mission design team you are tasked with the following:

1) Determine the Lagrange points of the Sun-Earth system and identify the most suitable Lagrange point for this mission
2) Determine the orbital path and the maneuvers required to achieve such path to place the telescope at the Lagrange point
3) Determine the launch vehicle you would be using to achieve this mission and location of the launch
4) Determine the cost per kg of payload and total cost of the mission

Submit a technical report of no more than 10 pages in length, including systems and trajectory diagrams, relevant equations and references. This 10-page limit excludes the signatory cover page. All algorithms (i.e. processes used to solve the equations) and the relevant MATLAB code used should be provided in two separate appendices. Assume this paper is to be submitted to the BSS technical director, i.e. they have a certain amount of technical knowledge.

The technical report should include the following sections:

Mission Statement:

- In your own words, describe the mission requirements and specifications

Orbit determination:

- Equation framework for Lagrange point determination
- Reasoning behind the choice of Lagrange point
- Orbit trajectories that would make the telescope go to the Lagrange point
- Orbit maneuvers/ Δv and Δm required
- Describe the orbit trajectory in-detail

Launch vehicle determination:

- Determine the appropriate launch vehicle and the company which provides it
- Provide the details of the selected launch site
- How many stages would the launch rocket be and how you have determined the number of stages? What would be the propellants used in each stage?