

Problem 2:

Given: Epoch date – 17 Sept, 2021; a) $a = 60000$ km, $e = 0.75$, $i = 60$ deg; b)

Find: a) periapsis, apoapsis, energy, a , semi-latus rectum, angular momentum, $[x,y,z]$ at start; b)
plot the three orbital configurations

Assume: Earth point mass model

a) $a = 60000$ km, $i = 60$ deg, $e = 0.75$

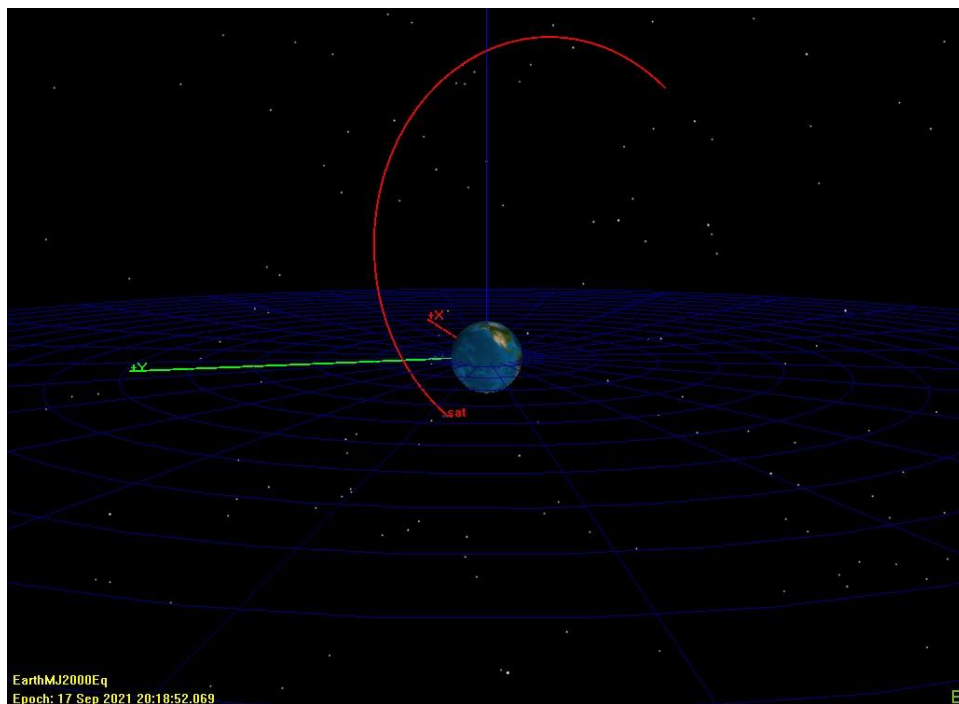


Figure 1 – GMAT Orbit of Satellite from part a

- i) Periapsis Radius
 - a. $R_p = 15000$ km
- ii) Apoapsis Radius
 - a. $R_a = 105000$ km
- iii) Energy
 - a. $E = -3.32167034583297 \text{ kg} \cdot \text{km}^2/\text{s}^2$
- iv) Semi-Major Axis

- a. $a = 60000 \text{ km}$
- v) Semi-Latus Rectum
 - a. $P = 26250 \text{ km}$
- vi) Angular Momentum
 - a. $[H_x, H_y, H_z] = [-71104.59089498752, -52835.43645781396, 51145.04274456859]$
 $\text{kg} \cdot \text{km}^2/\text{sec}$
 - b. $H = 102290.0854891372 \text{ kg} \cdot \text{km}^2/\text{sec}$
- vii) Cartesian Components and Velocity
 - a. $[x, y, z] = [20335.67334857766, -6912.068196538762, 21131.22867903336] \text{ km}$
 - b. $[x\dot{,}y\dot{,}z\dot{]} = [1.102798505242097, 2.140200795088907, 3.744106357034216] \text{ km/s}$

b) Sat 1 – Red, Sat 2 – Green, Sat 3 – Yellow

$i = 0 \text{ deg}$, $e = 0.75$, $a = 35000 \text{ km}, 60000 \text{ km}, 85000 \text{ km}$

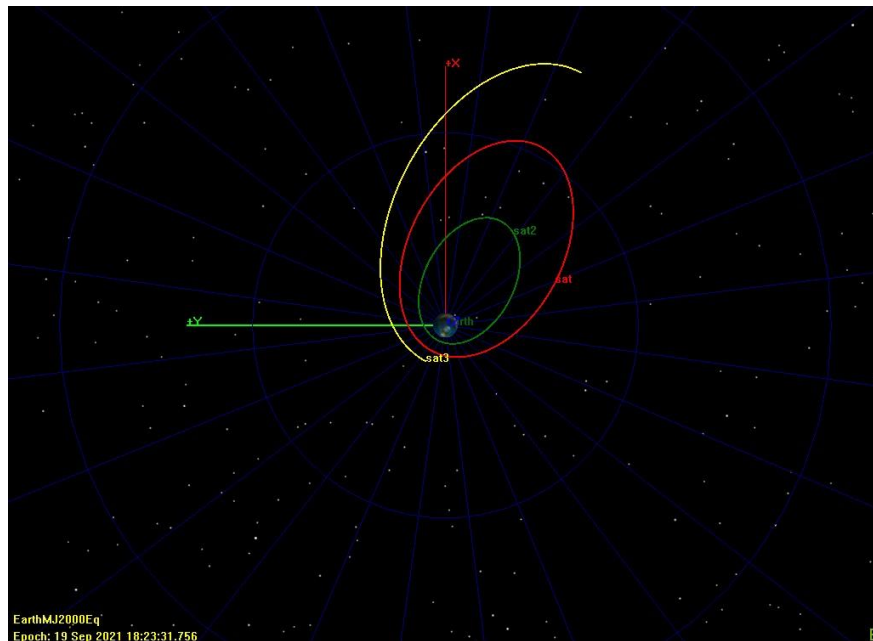


Figure 2 – GMAT Orbital Configuration b1

$a = 60000 \text{ km}$, $i = 45 \text{ deg}$, $e = 0.2, 0.5, 0.85$

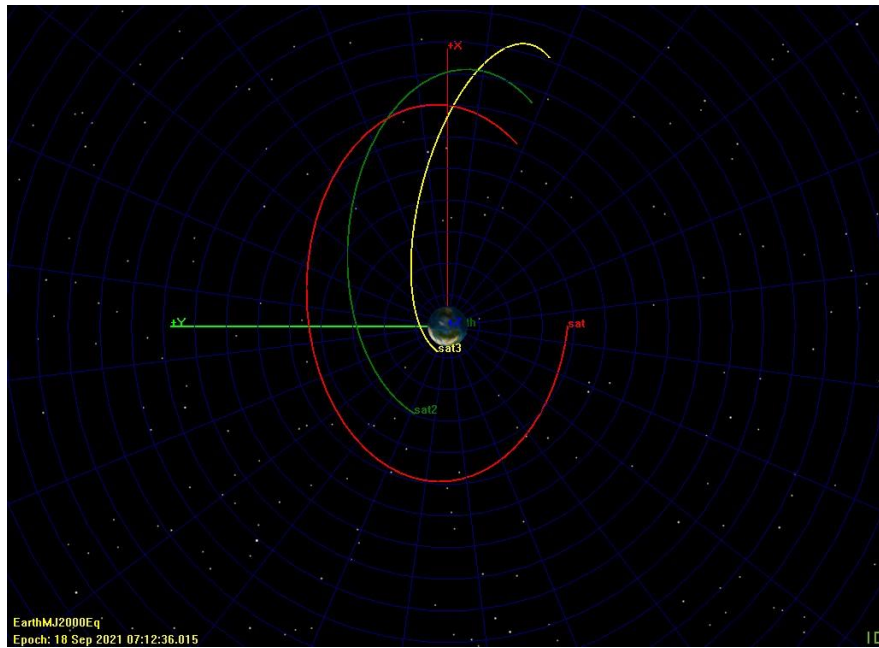


Figure 3 – GMAT Orbital Configuration b2

$i = 0 \text{ deg}$, $e = 0.6$, $a = 27500 \text{ km}, 45000 \text{ km}, 80000 \text{ km}$

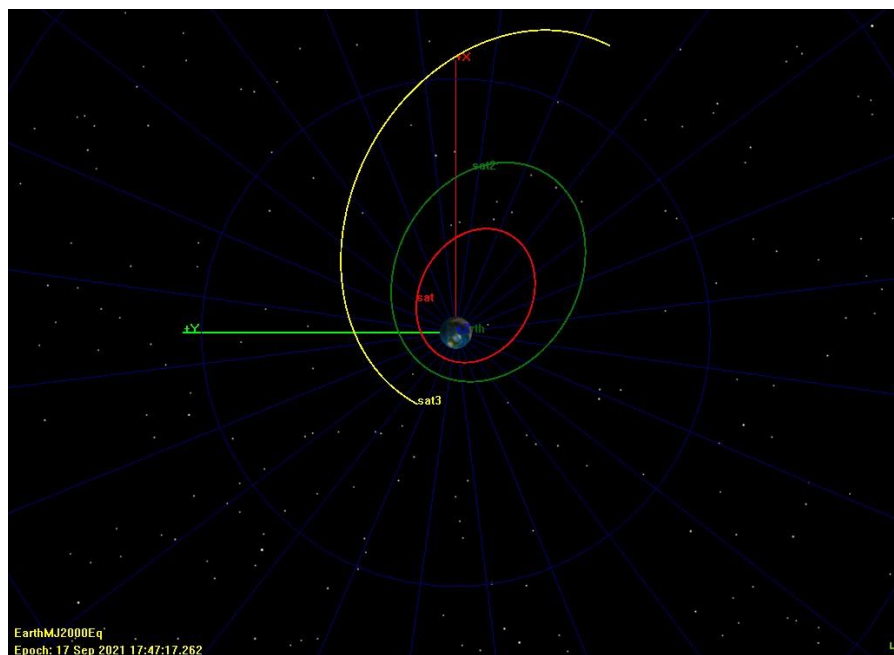


Figure 4 – GMAT Orbital Configuration b3