

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, All RAAN, AOP, and TA, set to values given in GMAT instruction manual

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

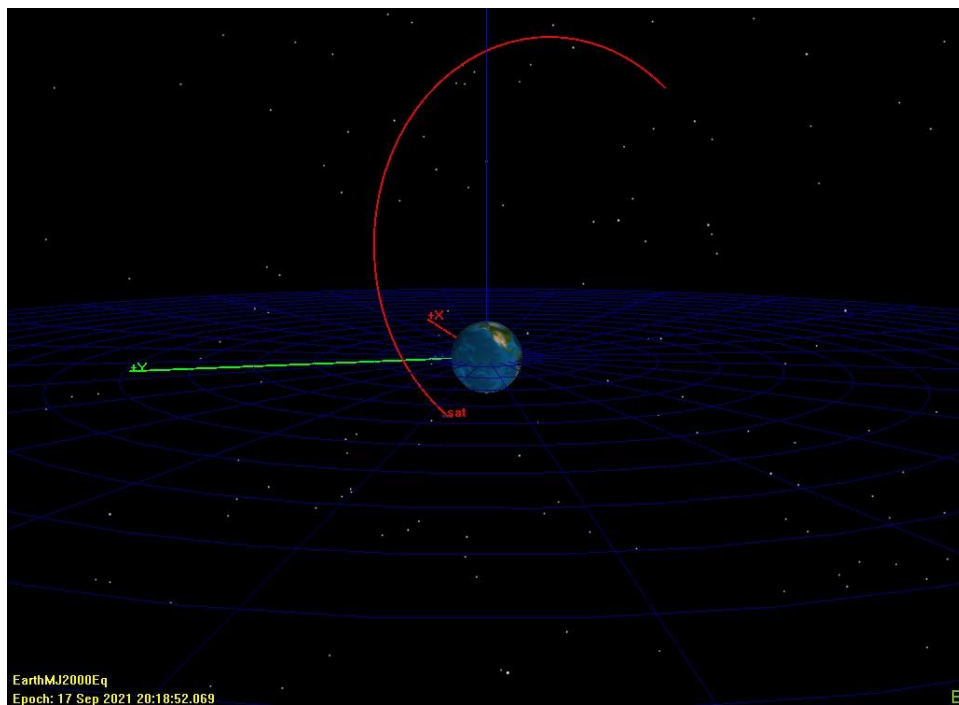


Figure 1 – GMAT Orbit of Satellite from part a

- 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

$i = 0 \text{ deg}$ ,  $e = 0.75$ ,  $a = 35000 \text{ km}$  (Sat 1),  $60000 \text{ km}$  (Sat 2),  $85000 \text{ km}$  (Sat 3)

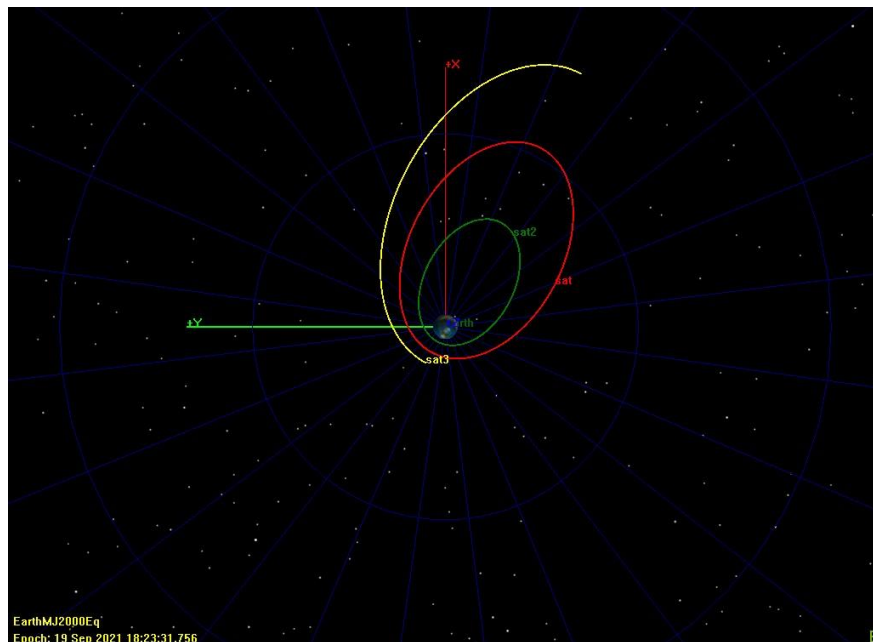


Figure 2 – GMAT Orbital Configuration b1

$a = 60000 \text{ km}$ ,  $i = 45 \text{ deg}$ ,  $e = 0.2$  (Sat 1),  $0.5$  (Sat 2),  $0.85$  (Sat 3)

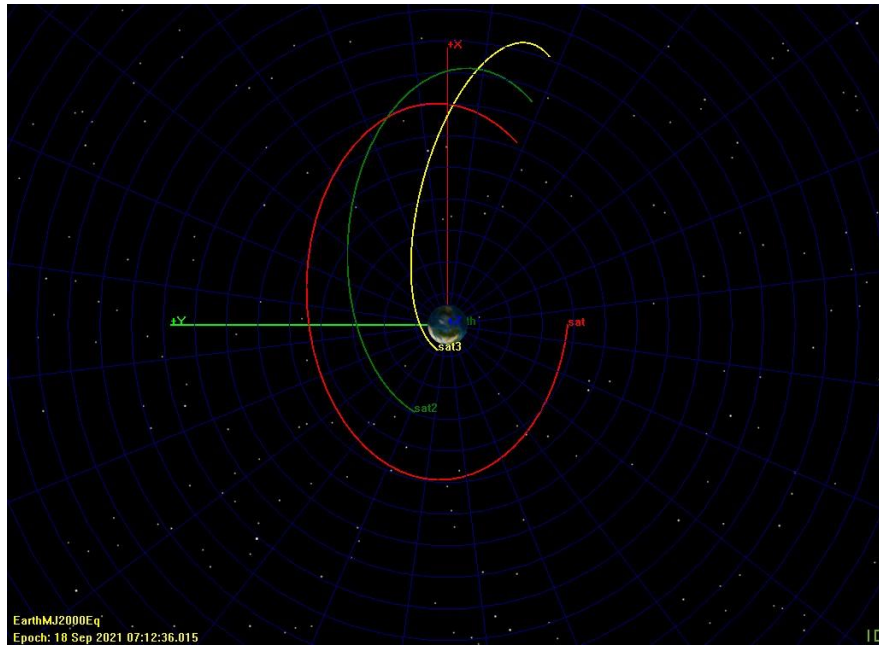


Figure 3 – GMAT Orbital Configuration b2

$i = 0 \text{ deg}$ ,  $e = 0.6$ ,  $a = 27500 \text{ km}$  (Sat 1),  $45000 \text{ km}$  (Sat 2),  $80000 \text{ km}$  (Sat 3)

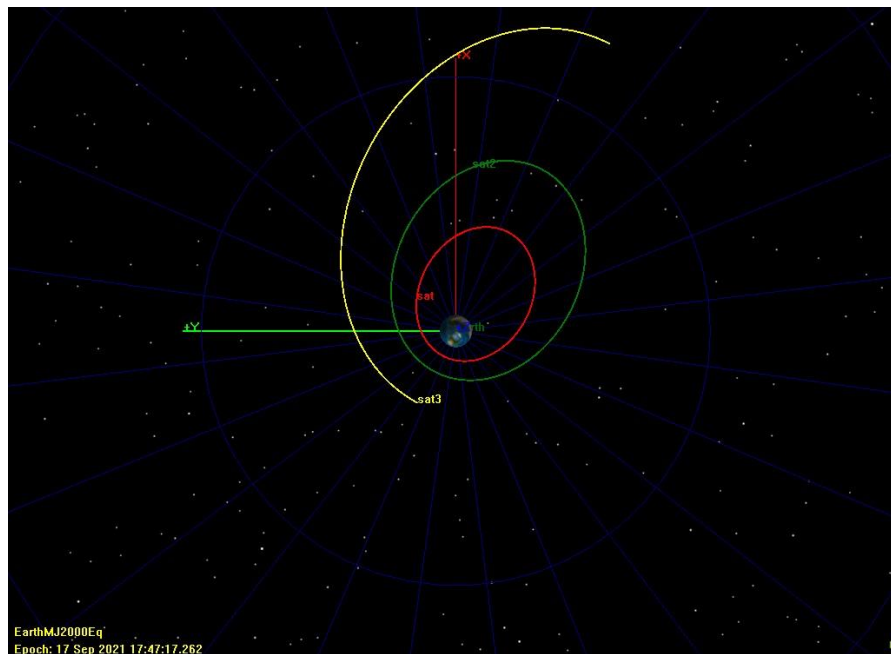


Figure 4 – GMAT Orbital Configuration b3