

## Homework #2 – ASEN 5050

**Due: Thursday, 9/10/2015**

Note: Use Appendix D of the book for all constants not given in the problem. Show the steps you take to arrive at your answers, unless otherwise noted. Handwritten is fine; word processor is great. I won't judge, but your future boss might.

1. **(18 pts (1 pt each))** For an Earth orbiting satellite with a semi-major axis of twice the Earth's radius and an eccentricity of 0.15, complete the following table (T-Tp is the time past periapse passage).

Note 1: Computing the eccentric anomaly requires iteratively solving Kepler's equation.  
Note 2: You don't need to show your work. Please show 2 digits past the decimal.

Case	True Anomaly (deg)	Eccentric Anomaly (deg)	Mean Anomaly (deg)	T-Tp (min)
A				0 min
B	30°			
C		200°		
D	90°			
E			270°	
F				25 min

2. **(14 pts)** The space shuttle orbiter is to deploy a satellite in 65 minutes. If the perigee height of the shuttle's orbit is 321 km, the apogee height is 551 km, and the true anomaly is 330°, what is the orbiter's true anomaly at the moment the satellite is deployed? Show your work.

3. **(15 pts (5 pts each))** A satellite has been *launched* into a 798 x 817 km orbit (perigee height x apogee height), which is very close to the *planned* orbit of 794 x 814 km. What is the error in the semi-major axis, eccentricity, and the orbital period?

4. **(28 pts (4 pts each))** Given the following position and velocity vector for a satellite:

$$\vec{r} = \begin{bmatrix} -5650.0 \\ -2650.0 \\ 2850.0 \end{bmatrix} \text{ km} \quad \vec{v} = \begin{bmatrix} 2.415 \\ -7.032 \\ -1.796 \end{bmatrix} \text{ km/sec}$$

Compute the following:

- The orbit semi-major axis
  - The orbit eccentricity
  - The minimum and maximum altitudes of the satellite above the Earth's (spherical) surface
  - The energy per unit mass of the satellite
  - The angular momentum vector
  - The inclination
  - The flight path angle
5. **(10 pts (5 pts each))** A satellite is at a distance of 8200 km from the Earth's center of mass. What are the conditions required on the satellite speed and the flight path angle such that the satellite's orbit is circular?
6. **(15 pts (5 pts each))** Let's say that Mercury's orbit about the Sun has a semi-major axis  $a = 0.387$  AU and eccentricity  $e = 0.205$ . What is Mercury's orbital period in years? What is the minimum and maximum distance between Mercury and the Sun? What is Mercury's maximum speed? (Use the conversions 1 year = 365.25 days, and 1 day = 86400 seconds).