AE 1350 Homework Assignment #5
Fall 2008

Handout: November 17, 2008
Due: November 24, 2008

Each problem is worth 10 points. Be sure to use appropriate units. Show all of the important steps in your solution. Box or double-underline your final answers. Be sure to follow all of the format guidelines for homework as discussed in the course overview. Homework will be collected at the *beginning* of the lecture on the above date due. Late homework will not be accepted.

Problems:

1) An Earth satellite has a semi-major axis of 10,000 km. The orbit eccentricity is 0.2. Find:
   (a) the periapsis and apoapsis radii and velocities,
   (b) the specific energy,
   (c) the angular momentum magnitude,
   (d) the orbital period, and
   (e) the radius and velocity magnitudes and flight-path angle for a true anomaly of 135 deg.

2) Beginning with conservation of energy and angular momentum, show that the speed of a satellite in circular orbit is:

$$V_c = \sqrt{\frac{\mu}{r}}$$

   and that $\gamma = 0$. With the Earth as the central body, calculate V_c at r=6578 km (low Earth orbit) and r=385,000 km (lunar orbit). Explain this trend.

3) At this moment there are several astronauts living in space aboard the International Space Station. The news often describes these people as being weightless. Are these astronauts truly weightless or do they simply feel weightless? Explain your rationale.

4) Recall the equation for the acceleration of body 2 relative to body 1 for the N-body problem derived in class. Assuming constant mass and the absence of non-gravitational forces, determine if the two-body problem is a good approximation when:
   a) m_j is very small, for all $j \geq 3$
   b) r_{j2} and r_{j1} are very large, for all $j \geq 3$
   c) $\vec{r}_{j2} \cong \vec{r}_{j1}$ and not large
   d) $m_3 \cong m_1$

5) The U.S. early warning defense system detects an unknown object headed to Earth. Ground tracking stations determine that at one point in its flight:

v = 9.0 km/sec
r = 7500.0 km
γ = 25 deg

Determine whether this is an ICBM, and Earth science satellite, or an interplanetary probe.

6) Given the orbital elements for Earth orbiting spacecraft A through F:

Spacecraft	**a (km)**	**e**	**i (deg)**
A	-13156	1.5	28.5
B	6800	0.0	0.0
C	10000	0.5	51.6
D	42164	0.25	28.5
E	6800	0.05	116.6
F	6500	0.0	30.0

Fill in the blanks to correctly complete the following statements. Multiple responses or None are possible solutions. <u>For full credit, be sure to give your rationale.</u>

a) [2 points] Spacecraft _____ is on an Earth escape trajectory.
b) [3 points] Spacecraft _____ is not in a two-body orbit.
c) [3 points] Spacecraft _____ could be an ICBM.
d) [2 points] Spacecraft _____ is in a circular orbit.