HomeWork # 4

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EET-3132 Remote Sensing

Chapter # 4

Q1: - Calculate the angular velocity with respect to the center of the Earth for a Geosynchronous orbit in rad/s?

ANS: - ω=V/R, Also $\omega = \frac{2\pi}{\tau} = \frac{2\pi}{86{,}400s} = 7.27 * 10^{-5}\text{rad/sec}$ or 85urad/sec

Q2: - Calculate the period for a circular orbit at an altitude of one Earth radius.

ANS: - $R_{Earth} = 6380\text{km}$

$$\tau = \frac{2\pi}{R_{Earth}}\sqrt{\frac{r^3}{go}} = \frac{2\pi}{6380km} * \sqrt{\frac{(2*6380km)^3}{9.8m/s^2}} = 14339\text{ sec } or\ about\ 4\ hours$$

Q3: - Calculate the period for a circular orbit at the surface of the Earth. What is the velocity? This is a "Herget" orbit, and is considered undesirable for a satellite.

ANS: - $R_{Earth} = 6380\text{km}$

Period = τ

$$\tau = \frac{2\pi}{R_{Earth}}\sqrt{\frac{r^3}{go}} = \frac{2\pi}{6380km} * \sqrt{\frac{(6380km)^3}{9.8m/s^2}} = 5076sec$$

Velocity = v

$$v = \sqrt{\frac{g_o}{r}}\ R_{Earth} = \sqrt{\frac{9.8\text{m/s}^2}{6380km}} * 6380\text{km} = 7907\text{m/s}$$

Q5: - Derive the radius of the orbit for a geosynchronous orbit.

ANS: - We know that

$$\tau = \frac{2\pi}{R_{Earth}}\sqrt{\frac{r^3}{go}} \quad \text{Implies that } r^3 = \left(\frac{R_{Earth}*\tau}{2\pi}\right)^2 * go$$

$$r = \sqrt[3]{\left(\frac{R_{Earth}*\tau}{2\pi}\right)^2 * go} = \sqrt[3]{\left(\frac{6380000*86400}{2\pi}\right)^2 * 9.8} = 41883.685\text{km}$$

Q6: - Can you see Antarctica from geosynchronous orbit?

ANS: - No, Antarctica cannot be seen from geosynchronous orbit because geostationary satellites does not cover that region.

Q7: - A satellite is in an elliptical orbit, with perigee of 1.5 Earth radii (geocentric), and apogee of three Earth radii (geocentric). If the velocity is 3.73 km/s at apogee, what is the velocity at perigee (what is the semi-major axis)? Hint: Use conservation of angular momentum: **L** = *m***v** × **r** = constant.

ANS: - L_A = mVa X Ra and Lp = mVa X Ra

mVa X Ra = mVa X Ra

$$\mathrm{V_{perigee}R_{perigee}} = \mathrm{V_{apogee}}R_{apogee}$$

$$\mathrm{V_{perigee}} = {V_{apogee}R_{apogee}}/{R_{perigee}}$$

$$\mathrm{V_{perigee}} = \frac{\left(3.73\frac{km}{s}\right) * 19.14X10^6\ m}{9.57\mathrm{X}10^6\ m}$$

$$\mathrm{V_{perigee}} = 7.46\mathrm{km/s}$$

Q4: - Look up the orbits for the nine planets and plot the period vs. the semi-major axis. Do they obey Kepler's third law? This is best done by using a log-log plot. Even better, plot the two-thirds root of the period vs. the semi-major axis (or mean radius).

Orbital Data for the Planets & Dwarf Planets

Planet	Semimajor Axis (AU)	Orbital Period (yr)	Orbital Speed (km/s)	Orbital Eccentricity (e)	Inclination of Orbit to Ecliptic (°)	Rotation Period (days)	Inclination of Equator to Orbit (°)
Mercury	0.3871	0.2408	47.9	0.206	7.00	58.65	0
Venus	0.7233	0.6152	35.0	0.007	3.39	-243.01*	177.3
Earth	1.000	1	29.8	0.017	0.00	0.997	23.4
Mars	1.5273	1.8809	24.1	0.093	1.85	1.026	25.2
Jupiter	5.2028	11.862	13.1	0.048	1.31	0.410	3.1
Saturn	9.5388	29.458	9.6	0.056	2.49	0.426	26.7
Uranus	19.1914	84.01	6.8	0.046	0.77	-0.746*	97.9
Neptune	30.0611	164.79	5.4	0.010	1.77	0.718	29.6
Dwarf Planets							
Ceres	2.76596	4.599	17.882	0.07976	10.587	0.378	~3
Pluto	39.5294	248.54	4.7	0.248	17.15	-6.4*	122.5
Haumea	43.335	285.4	4.484	0.18874	28.19	0.163	?
Makemake	45.791	309.88	4.419	0.159	28.96	?	?
Eris	67.6681	557	3.436	0.44177	44.187	> 8 hrs ?	?

ANS: -

Chap_4_Prob_4.m

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% Zeeshan Ahmad
% Submitted To: Prof. Viviana Vladutescu
% EET-3132 Remote Sensing, Spring 2016
% Problem 4, Chapter 4, RS from Air and Space

p = [0.248, 0.6152, 1, 1.8809, 11.862, 29.458, 84.01, 164.79, 248.54];
                 % Orbital Period (Year)
s = [0.3871, 0.7233, 1, 1.5273, 5.2028, 9.5388, 19.1914, 30.0611, 39.5294];
                 % Semimajor Axis (Astronimical Unit, 1 AU=149,597,871 km)
loglog(p,s);
title('loglog(p,s)')
xlabel('Period(yr)')
ylabel('SemiMajor-Axis(AU)')
%%
p = [0.248, 0.6152, 1, 1.8809, 11.862, 29.458, 84.01, 164.79, 248.54];
                 % Orbital Period (Year)
s = [0.3871, 0.7233, 1, 1.5273, 5.2028, 9.5388, 19.1914, 30.0611, 39.5294];
                 % Semimajor Axis (Astronimical Unit, 1 AU=149,597,871 km)
plot(p,s);
title('plot(p,s)')
xlabel('Period(yr)')
ylabel('SemiMajor-Axis(AU)')
```

Results