**King Fahd University of Petroleum & Minerals**

**Serial #**

- 1 points for not writing your serial number

Electrical Engineering Department

EE418: Satellite Communications (121)

**Quiz 2: Orbital Mechanics**

**Dr. Ali Muqaibel**

Name:

*(See back side for formulas and constants)*

A satellite, in a 1000 km high circular orbit, Determine:

1. The orbital velocity.

**h=1000; %km**

**u=3.986004418E5; %Km^3/S^2**

**re=6378.137; %km**

**v=sqrt(u/(re+h))**

$v$**=7.35013862 km/s**

1. The orbital period.

**T=2\*pi\*r/v**

$T=\frac{2πr}{v}=$ **6307.12**

1. The orbital angular velocity in radians per second

**v\_angular=2\*pi/T= 9.962052249251152e-004 rad/s**

For practical reasons, typical minimum elevation angles used by earth stations operating at Ku band in the commercial fixed services using geostationary satellites (FSS) communication bands is 15o.

* 1. Determine the maximum range in kilometers from an earth station to a geostationary in this band.

We can use the same procedure used in the HW or we can use the attached equations. First solve for $\cos((γ))$, then solve for $d$. Matlab code is shown

rs=42164.167;

El=15; % degrees

% converting to radians

El=El\*pi/180;

a=-(tan(El))^2-1;

b=2\*re/rs;

c=(tan(El))^2-(re/rs)^2;

cos\_central=(-b-sqrt(b^2-4\*a\*c))/2/a % There are two solutions

d=rs\*sqrt(1+(re/rs)^2-2\*(re/rs)\*cos\_central)

speed=2.997E8;

time =d\*1E3/speed

% round trip

time=time\*2

4.006086292121071e+004

* 1. To what *round-trip* signal propagation time do these ranges correspond?

The round trip propagation times, assuming the velocity of light is $2.997×10^{8}$ m/s, are given by

For the given band : $\frac{distance}{velocity}$ = $ 2×\frac{40.06086 km}{2.997×10^{8} m/sec}= 267.344 mSec. $

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 Good Luck, **Dr. Ali Muqaibel**