KING FAHD UNIVERSITY OF PETROLEUM & MINERALS
DEPARTMENT OF ELECTRICAL ENGINEERING

EE 418 INTRODUCTION TO SATELLITE COMMUNICATIONS EXAMINATION I
October 22, 2005

NAME :	
I.D. # :	

Q.1 Answer the following questions. (a question may have more than one answer)

1) **Some advantages of using satellites in the geostationary orbit are:**
   a. Use of hand held receivers b. No frequency shift due to Doppler effects
   c. Coverage of large area on the earth d. Reduction of transmission delay
   e. Provide communications 24 hours a day
2) **An azimuth angle is determined to be in the North-West direction. The numeric range of this azimuth angle is?**
   a. $0^{o} \rightarrow 90^{o}$ b. $90^{o} \rightarrow 180^{o}$ c. $180^{o} \rightarrow 270^{o}$ d. $270^{o} \rightarrow 360^{o}$
3) **The satellite speed at perigee, in an elliptical orbit, compared to its speed at apogee is:**
   a. Faster b. The same c. Slower.
4) **An earth station is located in Cape town (South Africa) at longitude -18.42^{o} and latitude -33.92^{o} . In which part of the sky would you locate a satellite with a sub-satellite point longitude of $+7^{o}$?**
   a. North b. North- East c. East d. South- East
   e. South f. South- West g. West h. North- West
5) **The use of communication satellites in highly elliptical orbits has the following advantages:**
   a. Provide 24 hour a-day communication.
   b. Provide coverage beyond latitudes of $\pm 76^{o}$.
   c. It provides relatively large bandwidth.
   d. Small Doppler shift.
6) **The angle between the orbital plane and the equatorial plane is:**
   a. The eccentric anomaly b. The true anomaly
   c. The inclination d. The right ascension of ascending node
7) **The cross polar discrimination in a dual polarization system, where $|E_{11}| = 126\ |E_{12}|$ is:**
   a. 21 dB b. 42 dB c. – 21 dB d. -42 dB

Q.2 Calculate the Julian date corresponding to 6:45 UT on April 18, 2006. How can you make use of this date in calculating the look angles to a given satellite? And what type of satellites?

Q.3 Calculate the look angles for an earth station at Cairo, Egypt to establish communications with NILESAT at 7^{o} West. Cairo location is 30.05^{o} North and 31.25^{o} East.

PROBLEM #	Q. 1	Q.2	Q.3	TOTAL
Marks				
Maximum	35	30	35	100

The Julian date at the beginning of each year

Year	Julian Date	Year	Julian Date
	2400000 +		2400000 +
1996	50083.5	2004	53005.5
1997	50449.5	2005	53371.5
1998	50814.5	2006	53736.5
1999	51179.5	2007	54101.5
2000	51544.5	2008	54466.5
2001	51910.5	2009	54832.5
2002	52275.5	2010	55197.5
2003	52640.5		

$$\cos(\gamma)=\cos(L_e)\cos(L_s)\cos(l_s-l_e)+\sin(L_e)\sin(L_s)$$

$$\therefore \cos(El)=\frac{r_s\sin(\gamma)}{d}=\frac{\sin(\gamma)}{\sqrt{1+\left(\frac{r_e}{r_s}\right)^2-2\left(\frac{r_e}{r_s}\right)\cos(\gamma)}}$$

The geo-synchronous radius r_s = 42242 km

The earth's radius r_e = 6370 km

$$a=|l_s-l_e|$$

$$c=|L_e-L_s|$$

$$\therefore s=0.5(a+c+\gamma)$$

$$\alpha=2\tan^{-1}\sqrt{\frac{\sin(s-\gamma)\sin(s-|L_e|}{\sin(s)\sin(s-|l_e-l_s|}}$$