بسم الله الرحمن الرحيم

King Fahd University of Petroleum and Minerals

Electrical Engineering Department

First Major EE 532

Tuesday November 15th, 2007

Duration: 1 hours and 30 mins.

Student Name	Student ID#
……	……...

Problem #1	
Problem #2	
Problem #3	
TOTAL /30	

Good Luck

Problem I**:** (10 points)

The Goldsone 80 meters reflector is a deep space antenna capable of communicating up to Pluto and beyond.

1. Calculate the directivity of this antenna in dB at 5 GHz and 35 GHz, assuming an aperture efficiency of 80% at 5 GHz, and 70% at 35GHz.
2. Estimate the 3-dB beamwidths at 5 GHz and 35 GHz.
3. If you are communicating with a satellite around Uranus (diatance 3000 Millions Km from earth), which frequency would you use (5 GHz or 35 GHz), assume the satellite carries a reflector antenna of 2 meters diametre. Explain your resonning.

Problem II: 10 points)

A very short ($l \leq \lambda / 50$) vertical electric diople is mounted on a pole a hight *h* above a flat perfectly conducting ground. The diople is used as a transmiting antenna in a VHF (*f* = 50 MHz) ground - to- air communication system. In order for this diople not to interfere with a nearby radio station, it is necessary a place a null in the diople antenna pattern at angle 80 degrees from the vertical (z-axis). What should be the shortest (in meters) in order to achieve such a specification?

Problem III: (10 points)

The normalized radiation intensity of an antenna is given by:

$$U = \sin^2\theta \sin^3\phi$$

If the intensity exists in the region $0 \le \theta \le \pi$, and $-\pi/2 \le \phi \le \pi/2$, and is zero elsewhere. Find:

1. The exact maximum directivity (dimensionless and in dB).
2. The azimuth and elevation half power beam-widths.
3. The antenna beam solid angle (Ω_A)
4. The approximate directivity and the percentage difference between the exact and approximate directivities.
5. The antenna maximum power gain, if the antenna loss resistance is $5\ \Omega$ and its radiation resistance in $120\,\Omega$.