S11 PHY114 Problem Set 8

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1.

- Find the wavelength of the radio waves emitted by the University of Rochester radio station (88.5 Mhz)?
- The number of bits per second transmitted on a radio signal is about ten times less than the frequency of the wave. A wireless local area network (WLAN) requires about 100 Mbits/sec. What frequency and wavelength of radio waves are needed?
- Visible light has wavelength in the range of 380-750nm (violet to red). Find the corresponding frequencies.
- The Voyager 1 spacecraft is now at a distance of 117 AU (astronomical unit-the distance between the Earth and the Sun). If you send a signal to Voyager 1, how long would you have to wait for a response?

2. A geosynchronous satellite orbits at the same as rate as the Earth's rotation, so that to an observer on the Earth it will appear stationary in sky. At what latitude should this satellite be located in the sky? At what angle to the horizontal should a satellite antenna at Rochester have to be pointed, assuming that the longitude of the satellite is the same as ours? At what latitude would communication with a geosynchrnous satellite become impossible?What is the time delay in a telephone signal which is bounced off a satellite in geoscynchronous orbit ? A quarter-second delay would be noticeable.

3.

- Estimate the average optical power output of the Sun, knowing that about 1000 Watts per square meter reaches the Earth.
- A radio telescope can detect signals as low as $10^{-23} W m^{-2}$. Assuming that the maximum power of an alien radio transmitter is about the same as that of a star, what is the maximum distance from which we can expect to recieve a signal?

- The United States consumes about $30 \times 10^{15} Wh$ (Watt-hours) of energy in a year. How large a field of solar panels would it take to power this usage? Assume a 10% efficiency for solar panels.

4. Calculate the displacement current between the square plates of side $9.0cm$, of a capacitor if the electric field is changing at a rate of $1.8 \times 10^{6} V(ms)^{-1}$.