Arab Academy For Science, Technology & Maritime Transport.

Course Title: Satellite Communication System

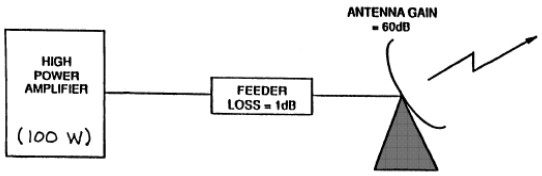
Course Code: EC 520

Sheet 3

1- For P_T of 10 watts, then at distances of 1m, 10m, 100m and 1km. Calculate the PFDs.

2- For an antenna P_T of 10W and Gain, G_T of 1,000 . Calculate EIRP in dBW.

3- A high power amplifier transmits power of 100 W feeder loss is 1 dB and with gain 60 dB.
Calculate the EIRP.



4- Parabolic antenna of diameter 1m and efficiency of 60% operating at 3 GHz. Calculate the antenna`s gain.

5- Under the free-space path-loss model, what is the transmit power required to obtain a received power of 1 dB for a wireless system with isotropic antennas (gain is 1) and a carrier frequency of 5 GHz, assuming a distance of 20 m.

6- A microwave transmitter with an output of 0.5 W at 2 GHz is used in a transmission system, where both the transmitting and receiving antennas are parabolas, each 1 m in diameter. Suppose the two antennas are directionally aligned and are 10 kms apart. (antenna efficiency=0.56).
   (a) What is the effective radiated power of the transmitted signal, in W and dB?
   (b) What is the available signal power out of the receiving antenna?

7- A low earth orbit satellite at height of 500 km. receives a transmitted signal at 3.1GHz. from a ground station. The ground station transmits signal at 1 kW through a 4m. diameter parabolic antenna that has an effective gain of 19,000. The satellite antenna has diameter 1m and an effective gain of 1,250. Calculate the received power P_R.

8- Using same transmit power, frequency and antenna for a satellite in geostationary orbit (d = 35,786 km). Calculate the received power P_R.

9- A geostationary satellite carries a transponder with a 20 watt transmitter at 4 GHz. The transmitter is operated at an output power of 10 watts and drives an antenna with a gain of 30 dB. An earth station is at the center of the coverage zone of the satellite, at a range of 38,500 km. Using decibels for all calculations, find:
   (a) The flux density at the earth station in dBW/m^2.
   (b) The power received by an antenna with a gain of 39 dB, in dBW.
   (c) The EIRP of the transponder in dBW.

10- A LEO satellite has a multi-beam antenna with a gain of 18 dB in each beam. A transponder with transmitter output power of 0.5 watts at 2.5 GHz is connected to one antenna beam. An earth station is located at the edge of the coverage zone of this beam, where the received power is 3 dB below that at the center of the beam, and at a range of 2,000 km from the satellite. Using decibels for all calculations, find:
   (a) The power received by an antenna with a gain of +1 dB, in dBW.
   (b) The noise power of the earth station at the input of the receiver for a noise temperature of 260K and an RF channel bandwidth of 20 kHz.
   (c) The C/N ratio in dB for the LEO signal at the receiver output.

11- A receiving system employs 36 dBi parabolic antenna operating at 12 GHz. The antenna noise temperature is 50 K, and the receiver front-end noise temperature 110 K. Calculate G/T in decibels per Kelvin.

12- The C/N ratio of Up-link of 60 dB.Hz and down-link of 40 dB.Hz . Calculate the C/N of the system.

13- Calculate the **C/N** ratio of an up-link to a geosynchronous satellite(altitude=35786km) that has the following characteristics and equipment values:

- Frequency 6 GHz;
- Transmitter Power 100W;
- Transmit antenna diameter 4.5 m; Efficiency 70%
- Maximum expected Atmospheric Loss(Rain) 3 dB
- Maximum expected Alignment Loss 1 dB
- Receiver antenna diameter 0.4 m; Efficiency 55%
- Receiver Noise Temperature 2584°K
- Carrier Bandwidth 10MHz.
- Boltzmann's Constant, k, -228.6 dBW/Hz/K

14- Calculate the C/N ratio of a down-link to a geosynchronous satellite (altitude=35786km) that has the following characteristics and equipment values:

- Frequency 4 GHz;
- Transmitter Power 20W;
- Transmit antenna diameter 0.4 m; Efficiency 55%
- Maximum expected Atmospheric Loss(Rain) 3 dB
- Maximum expected Alignment Loss 1 dB
- Receiver antenna diameter 4.5 m; Efficiency 60%
- Receiver Noise Temperature 435°K
- Carrier Bandwidth 10MHz.
- Boltzmann's Constant, k, -228.6 dBW/Hz/K

15- Calculate overall system **C/N** ratio of the combined links from examples 16 & 17 and thus the expected BER if this link was used to carry baseband data at (a) 5Mbps. and (b) 8Mbps using PSK modulation.

The ratio $\mathbf{E_b/N}$ is graphed below against BER for PSK modulation