General Sir John Kotelawala Defence University

ET3122 Antennas and Propagation Revision Exercises

Upeka Premaratne

Department of Electronic and Telecommunication Engineering
University of Moratuwa

April 18, 2024

Question 1

A power amplifier with an output of 200 mW is connected to a 50 Ω transmission line which is subsequently connected to an antenna with an impedance of 58+j10 Ω. If the output impedance of the power amplifier is 48 Ω calculate

1. the reflection coefficient between the power amplifier and transmission line
2. the reflection coefficient between the transmission line and antenna and
3. the power radiated from the antenna.

Question 2

The antenna of a low power microwave communication module reflects 6.3% of the power back in to the transmission line. Calculate the VSWR between the transmission line and antenna.

Question 3

An antenna datasheet mentions the maximum VSWR as 1.5 dB. Find the maximum possible value of the reflection coefficient ρ_0.

Question 4

A paraboloid reflector antenna has a radius of 3.2 m and it is operated at 12.5 GHz. Since it is made out of mesh instead of solid metal it has a low effective aperture of 0.7 times the physical aperture.

1. What is the gain of the antenna?
2. Briefly discuss the benefits of using a mesh instead of solid metal for the reflector

Question 5

A safety critical industrial sensor node requires a wideband antenna to handle a frequency range of 2.4 - 3.8 GHz for redundancy. A $\lambda/4$ log periodic antenna is suggested for this purpose.

1. Briefly explain how wideband operation is achieved in a log periodic antenna.
2. If the antenna has to be 20 cm long and the minimum spacing between two elements has to be above 5 mm, verify if the design will be feasible for 5, 9 and 15 elements.

Question 6

A microwave link operates at 11 GHz. The transmitting antenna is 10 m above mean sea level (MSL) and the receiving antenna is 9 m above MSL. The two antennas are 10 km apart and the terrain profile between the two antennas is flat with an elevation at MSL. Two building construction projects A and B have been proposed on the flat ground between the two antennas. The distances from the transmitter to sites A and B are 2 km and 5 km respectively.

1. Calculate the earth bulge at each location.
2. Find the required first Fresnel zone clearance (F_1) at each location.
3. Hence, calculate the maximum allowable MSL height of each building to ensure line of sight. The Fresnel clearance must be taken as 40% of F_1.