Assignment: Antennas and Propagation

This assignment involves participation in the online IEEE RFID 2020 conference, 28 Sep – 16 Oct 2020.

Questions (Attach Responses):

1. A dielectric sphere with radius r has the following permittivity profile: Answer the following questions based on this information.
   a. If an electromagnetic wave strikes this object at \( \theta = 0 \) degrees of elevation, where does the reflected/scattered waves travel?
   b. What is this type of sphere called? What manufacturing innovation has made fabrication of this device much more practical?
   c. What applications does it have for radiolocation?

2. A tunnel diode, when biased intermittently and placed at the load of an RF tag antenna, reflects more power than is received. Answer the following questions based on this scenario.
   a. What application does this type of device allow? Cite a paper to reference your answer.
   b. If an RF tag reflects with 30 dB of gain switching between active bias and matched load (compared to open-circuit and matched load), what is the equivalent impedance load of the active bias if this load is purely resistive?

3. A bistatic backscatter link involves a transmitter, a backscatter RFID tag, and a receiver at three different locations. Transmitter, tag, and reader antennas all have 0 dBi antenna gains with negligible tag losses in free space at 915 MHz. If the transmitter sends 1 Watt of power into the transmit antenna and illuminates an RF tag 10 m away, how far away can the bistatic receiver unit be and still receive a signal level of -80 dBm (the receiver’s minimum level for reliable signal decoding).

4. Patch antennas are often used to transmit and receive in RFID readers.
   a. How does a V-shaped dual patch array differ from a conventional square patch antenna?
b. How does the V-shaped dual patch array differ electrically from a conventional square patch antenna? Use either paper citation or a computer simulation of a square patch antenna to compare.

c. What application does a V-shaped dual patch array enable?

5. A rotary craft with 10 cm blades rotating at 800 revolutions/minute. The Doppler signature from a radar interrogator can produce some interesting information for detecting the presence of a rotary craft vehicle.

   a. What is the base Doppler frequency measured if interrogated with a 2.4 GHz continuous wave radar?

   b. Explain how the radar signature can be used to differentiate types of rotary craft.