RFID INFOSEC Homework #4, ver. 2.0
Assigned Oct. 31 and Due Nov. 7, 2008

Name: ________________________________
ID: ________________________________

51 pts.

Show all your work. Without proper justification and details of steps, correct answers alone may not carry full credit.

Notes:
- Minus 3 points if your homework is not stapled in the upper left-hand corner.
- Minus 2 points if you use the back of your paper. Please only use a single side.
- Minus 2 points if you present the worked problems out of order. In other words, please present the problems in the order assigned, 1, 2, 3, ...

1. For each of the following frequencies, determine the wavelength.
   a. 2.4 GHz (2 pts)
   b. 915 MHz (2 pts)
   c. 13.56 MHz (2 pts)
   d. 125 KHz (2 pts)

2. A reader dipole antenna is approximately 35 cm measured end-to-end. What is the approximate frequency of this system? (5 pts.)

3. What is the maximum allowed 20 dB bandwidth of the hopping channel in UHF passive RFID in the USA? (5 pts.)

4. Give the center frequency for Gen2’s channels 1, 33, and 50 in the USA. (3 pts.)

5. A system consists of an amplifier, feedline, and antenna in series. For a 25 mV input to the amplifier, the output is 100 mV. The feedline loss is 2 dB. The antenna gain is 3 dBd. What is the overall gain of the system? (5 pts.)

6. The maximum theoretical distance of a UHF passive RFID system is approximately 50 feet with a 15 dBi antenna. Given you cannot change the frequency, reader transmitted power, reader antenna gain, or tag antenna gain, what system parameter can you change to extend the distance to over 100 feet? Give at least two design alternatives. (10 pts.)

7. Derive the decibel version of the Friis formula. (10 pts.)

8. The reader transmitted power is 50 milliwatts. The gain of the reader antenna is 8 dBi. The tag requires 100 microwatts to operate. The gain of the tag antenna is 1 dBi. For 915 MHz, what is the theoretical maximum distance at which the tag will receive enough power to power its circuits? (5 pts.)

9. A reader antenna has a gain of 12 dBi. To be legal in the USA, what is the maximum power in watts that the reader can transmit? (5 pts.)

10. A 13.56 MHz RFID-enabled smartcard antenna is a loop with two sides having a length of 8 cm and two sides having a length of 5 cm. What is the approximate boundary between the near field and far field areas? (5 pts.)