Remote sensing S-92.3132
Examination May 15, 2012
At 09:00-12:00 S1
No additional material is allowed

1. Explain these terms

   a) Polarization
   b) Sun synchronous orbit
   c) Spectrometer
   d) Blackbody
   e) Speckle

2. Explain the working principles of LIDAR and SAR? What are the major LIDAR applications? What are interferometry and polarimetric SAR-measurements? Give some examples of SAR applications.

3. Radiometry.

   a) Explain, with a block diagram, how the antenna temperature (T_A) is calculated from the output voltage (v_{out}) of a radiometer in the case of a 1) total power radiometer and 2) Dicke-type radiometer.

   b) Explain how the uncertainty in the gain of the receiver affects the antenna temperature in the case of the two radiometer types. Consider a case, in which the two radiometers (B=200 MHz, T_R = 300 K, Tphys=290 K, tau=1s, G = 70 dB, DG/G = 0.15 %) measure the same antenna temperature (TA = 200 K).

4. A radiometer system has an antenna, which is connected to an RF amplifier by a lossy cable (L = 1.5 dB). The RF amplifier (F = 5 dB, G = 28 dB) is connected to a mixer-amplifier (F = 8 dB, G = 6 dB) and the mixer-amplifier is connected to an IF amplifier (F = 6 dB, G = 20 dB). Physical temperature of the system is 280 K and the antenna temperature is 300 K. The bandwidth is 500 MHz and the integration time is 0.1 s.

   a) Calculate noise figure and noise temperature.
   b) Calculate sensitivity of the radiometer system.
   c) How to reduce the system noise figure?

5. An airborne pulse radar is at a height of 7 km and measures a target with a distance of 10.2 km. What is the backscattering coefficient, when the power of the transmitted pulse is 500 W and the received power is -41 dBm. The antenna diameter is 1.4 m and radar operation frequency is 8.25 GHz. The antenna is assumed to be ideal. The antenna gain can be approximated with $G \approx 4\pi/(\theta_{3dB})^2$.

Constants:
$c = 299792458$ m/s
$k = 1.3807 \cdot 10^{-23}$ J/K
$h = 6.6261 \cdot 10^{-34}$ Js