S-26.3120 Radio Engineering, laboratory course

Examination part A, 10.2.2014, 2:15–3:45 p.m., I256

Maximum 20 points in part A, and another 20 points in part B*.

Part A (today): Use of any material and literature is *not* allowed!

(Kaikkeihin tehtäviin saa vastata suomeksikin!)

1. Discuss *briefly* the following topics (max. 10.5 points):

   a) *ENR* of a noise source (1.5 p.)

   b) *XPD* of an antenna (1.5 p.)

   c) TDR measurements (1.5 p.)

   d) Passive intermodulation (1.5 p.)

   e) Anechoic chamber (1.5 p.)

   f) Measurement uncertainty (1.5 p.)

   g) Oscillator phase noise (1.5 p.)

2. Write a concise *essay* (1-2 pages) on the topic: Which phenomena limit and determine the dynamic range of a spectrum analyser, and how can those factors (and therefore the dynamic range) be influenced during measurements? The essay can include illustrative sketches. (max. 9.5 points)

*Remember: Exam part B is held on 17.2.2014, at 2:15-3:45 p.m. , in I256

S-26.3120 Radio Engineering, laboratory course

Examination part B 17.2.2014, 2:15–3:45 p.m., I256

Maximum 20 points in part A (last week), and another 20 points in this part B.

Part B: Use of literature and own notes is allowed
Note: Also the viewing of pdf/e-books on your laptop/tablet is allowed, but any use of web browsers, communications (e-mail/chat) or programmable calculus software (e.g. Matlab) is prohibited!

Please use a separate paper for each problem!

(Kaikkeihin tehtäviin saa vastata suomeksikin!)

Maximum 10 points for each problem.

3. You are measuring an antenna. You should measure the sidelobes at an expected sidelobe level of -20 dB with an uncertainty lower/better than ±1.3 dB.
   a) Find the required reflectivity level of the measurement range to reach this uncertainty. Assume that other sources of error have no significant effect. (7 p.)
   b) Now you measure the mainlobe of the antenna. Determine the uncertainty in the measurement of the antenna pattern maximum due to the reflectivity level calculated in a) (if you didn't solve a) use a plausible value for the reflectivity level). (3 p.)

4. Let us consider a receiver in mobile communications operating at $T_0 = 230$ K, receiving an RF signal with a level of -40 dBm at the antenna port. The signal/system bandwidth is 40 MHz. The 1-dB compression point is 0 dBm. For successful detection, the signal strength has to be 10 dB above the receiver noise floor. In what range (i.e. X-Y dB) is the required dynamic range of the receiver when the noise factor of the receiver chain is $F = 2.1$ with an uncertainty of ±5.5 %? (10 p.)

(May be useful: Boltzmann constant = $1.38 \cdot 10^{-23}$ m^2 kg s^{-2} K^{-1})