**Written exam March 11ᵗʰ 2014**

Wireless networks (EP2950, HI2001)

Help material: pocket calculator and four handwritten A4 pages (two sheets).
Maximum points: 50p. The preliminary limit for passing the course is 25p with grade E to A in steps of approximately 5p.

1. A Bluetooth device is transmitting with 0dBm indoors. Assume a fading margin of 10dB, an antenna gain of 1dB for both transmitter and receiver. What is the maximum distance (with line-of-sight) between transmitter and receiver if the receiver wants – 80dBm? (4p)

2. Explain what hidden terminals mean in wireless networks and suggest methods to solve the problems related to hidden terminals. (4p)

3. What is the thermal noise level of a channel with a bandwidth of 10kHz carrying 1000W at the temperature 50°C? (4p)

4. Show that $E_b/N_0 = S/(kTR)$, where E_b is the energy per bit, N_0 is the noise per hertz, S is the signal power, R is the data rate and T is the temperature in Kelvin. (4p)

5. How many check bits are needed if the Hamming error correction code is used to correct and correct single bit errors in a 1024 bit data word? (4p)

6. Explain the difference between sniff mode, hold mode and park mode in Bluetooth. (4p)

7. In CDMA network, seven channels transmit the following data bits using spreading codes (see the figure below). Show how bit value from channel five is obtained from the aggregated signal. (6p)
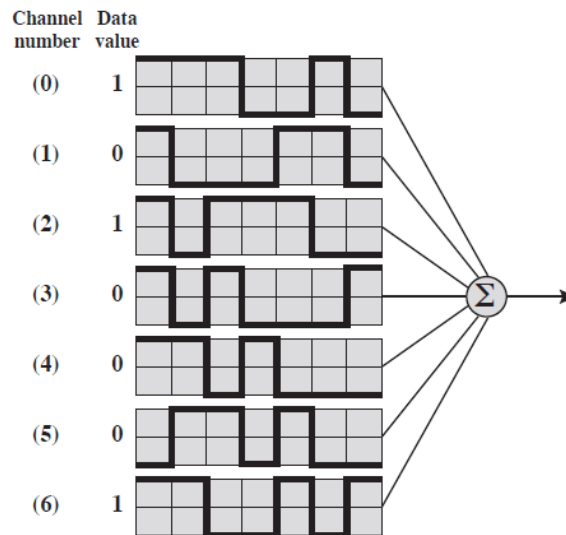
8. Describe the differences between hard, soft and softer handover procedures. (4p)

9. In IEEE 802.11, the stations have two different ways to detect if the medium is busy. Describe these two ways. (4p)

10. When a station wants to associate to an access point (AP), the station performs a scanning to discover access points in the proximity. Describe the possible ways for a station to discover the access points. (4p)

11. What is the reason for having four address fields in the MAC header in wireless Ethernet (IEEE 802.11) instead of two address fields as in wireline Ethernet? (4p)

12. A Bluetooth slave receives a POLL packet. Let the previous values be ARQN=1 and SEQN=0. What will be the values of ARQN and SEQN when a NULL packet is transmitted? The answer has to be motivated. (4p)