

Concordia University
Department of Electrical and Computer Engineering
ELEC6141/ELEC464: Wireless Communications
Final Exam
April 15, 2011

- 1) For a cellular system using TDMA and 120° sectoring, find the value of N if the path loss exponent is $n = 3.5$ and the minimum required Signal-to-Interference Ratio is 20 dB (5 Marks).
- 2) A cellular system uses four cell reuse with 120° sectoring. The total number of channels is 280. A typical user makes, on the average, 10 calls per day and the average duration of each call is 3 minutes.
 - a) Find the number of users per cell if $GOS=0.01$ (5 Marks).
 - b) Find the total number of users if the serving area is 400 square km. and the cell radius is 1 km (2 Marks).
- 3) In a three branch selection diversity scheme the probability that the SNR falls below 13 dB is 10^{-5} .
 - a) Find the average SNR per branch in dB. Assume that all branches have the same average SNR (3 Marks).
 - b) Find the probability that the SNR falls below 13 dB if two of the branches have an average SNR of 20 dB while the third branch has an average SNR of 30 dB (2 Marks).
- 4) In a maximal ratio combining diversity scheme the average SNR per branch is 20 dB. What is the number of branches required so that the probability that the SNR falls below 14 dB is 10^{-5} (5 Marks).
- 5) a) Find the generator polynomial of the (63, 59) RS code defined over GF(64) (5 Marks). b) Draw the encoder's block diagram (2 Marks). c) What is the rate of the code (1 Mark)? How many errors it can correct (1 Mark)? d) What are the codeword length in bits and the number of information bits in a codeword? (1 Mark)
- 6) A communication system uses TDMA with 8 time slots. The number of bits per time slot is 150 and the frame duration is 4 ms.
 - a) Find the total bit rate and the bit rate of each user (4 Marks).
 - b) If GMSK modulation with $BT=0.25$ is used, find the required bandwidth such that only 1% of the energy falls out of the band (2 Marks).
 - c) Find the bit error probability of the system if $\frac{E_b}{N_0} = 8$ dB (2 Marks).
 - d) Find the bit error probability (before and after decoding) if the information is encoded using a (31, 25) RS code over GF(32) prior to transmission (3 Marks).
 - e) For the encoded system find the required bandwidth such that only 1% of the energy falls out of band (2 Marks).
- 7) In a slotted ALOHA system, the channel bit rate is 10 Mbps and the length of each packet is 1000 bits. Each terminal generates 16 packets per second on the

average. What is the maximum number of terminals that the system can support (5 Marks).

- 8) A cellular system uses CDMA. The thermal signal-to-noise ratio ($\frac{E_b}{N_0}$) is 13 dB

and the required bit error rate is 10^{-3} . The bit rate of each user is 10 kbps.

- a) What is the required bandwidth (chip rate) if the number of users per cell is 40 (5 Marks)?
 - b) What would be the number of users per cell if 60° sectoring is used and the voice activity factor of 0.4 is assumed (2 Marks)?
- 9) In a communications link the received signal (in dBm) is presented using a log-normal model as,

$$P_r(d) = 15 + X_\sigma,$$

where X_σ is a Gaussian random variable with mean zero and variance $\sigma = 10$ dB.

Find the probability that the received signal exceeds 25 dBm (3 Marks).