• Solve each problem completely, showing each step. Each successful step shown can be awarded partial credit. For example, write down the definition before doing the math.

• Feel free to use extra sheets to answer any question. Include these extra sheets with the exam booklet and label each sheet with your name.

• For clarity, copy your final answer to the box after the question. (Short answer sentences do not need to be copied.)

• There is no partial credit on multiple choice questions – so there’s no need to show your work.

• You should answer short answer questions in two sentences or less. Too many sentences may result in a deduction of points.

• You will have 60 minutes for this exam.

• You may have your portfolio (written homework / example problem descriptions and work).

• THIS IS THE EXAM FOR 6325 STUDENTS.
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Figure 7.5: $P_{\text{out}}$ for maximal-ratio combining with i.i.d. Rayleigh fading.

Figure 7.11 Graph of probability distributions of $\text{SNR} = \gamma$ threshold for $M$ branch selection diversity. The term $\Gamma$ represents the mean SNR on each branch [from [Jak71] © IEEE].
Problems

1. (20 pts) Let the generator matrix $G$ and syndrome matrix $S$ be given as,

$$G = \begin{bmatrix} 1 & 0 & 0 & 0 & 1 & 1 \\ 0 & 1 & 0 & 1 & 0 & 1 \\ 0 & 0 & 1 & 1 & 1 & 0 \end{bmatrix}, \quad S = \begin{bmatrix} 0 & 1 & 1 \\ 1 & 0 & 1 \\ 1 & 1 & 0 \\ 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}$$

(a) Determine the coded bits when the three data bits are $[1, 0, 1]$. 

(b) The coded bits $[1, 0, 0, 1, 0, 0]$ are received. Determine the data bits sent.
2. (20 pts total) Compute the first seven bits of output of the given 3-stage LFSR above. Assume the starting state is $s_1 = 0, s_2 = 1, s_3 = 0$. 

![LFSR Diagram]
3. (10 pts) We have a four-antenna receiver using selection combining. We have set the fade margin to 10 dB. What is the probability that our received signal power will be lower than 10 dB below its mean?
4. (12 pts total) Short answer (Two sentences max): Why do collisions occur in CSMA?

5. (12 pts total) Short answer (Two sentences max): Why are Walsh-Hadamard functions used in the IS-95 downlink?
6. (20 pts) Short answers (Two sentences max): Why does interleaving introduce latency? What is the benefit of interleaving?

7. (6 pts total) Multiple Choice: For a maximal length sequence generated by a \( n \)-stage LFSR, how long is the generated maximal length sequence (before it starts repeating)? Circle the ONE correct answer.

(a) \( n - 1 \)
(b) \( 2^n - 1 \)
(c) \( 2^n \)
(d) \( 2^n + 1 \)
(e) \( 4^n + 1 \)
(f) it never repeats