EE433 Learning Objectives

Lecture 1: Gain and dB Review

1. Calculate voltage, current, and power gains for single and multistage systems.
2. Express power gain and voltage gain in decibels.
3. Express power levels in dBm and other reference levels.

Lecture 2: Noise, Noise Power, and Noise Figure

1. Perform calculations of thermal noise voltage.
2. Perform calculations of signal-to-noise ratio, noise ratio, and noise figure.
3. Apply noise equation to find the noise figure for a multistage system.

Lecture 3: Major Wireless Standards

1. Describe the evolution of wireless cellular communication from wired communications.
2. Describe the development, features, and improvements of 2^{nd} and 3^{rd} generation wireless standards.
3. Explain the terms FDMA, TDMA, and CDMA as they relate to cellular systems.
4. Explain the characteristics of the major 2^{nd} generation wireless standards (GSM and CDMA).

Lecture 4: Cell Planning, Frequency Reuse and System Capacity

1. Explain how frequency reuse increases system capacity.
2. Calculate system capacity for various reuse factors.
3. Describe the techniques providers can use to improve system capacity.

Lecture 5: Cell Planning, Frequency Reuse and System Capacity

1. Describe the impact of reuse number on signal to interference ratio (SIR).
2. Calculate total interference power at a cell edge.
3. Calculate the SIR at the cell edge for various reuse numbers and levels of interfering users.

Lecture 6: Trunking and Grade of Service (Voice)

1. Describe the reasons for using Trunked systems rather than dedicated lines.
2. Calculate the probability of blocking for Erlang B systems.
3. Explain different techniques for improving Grade of Service.

Lecture 7: Trunking and Grade of Service (Data)

1. Calculate the probability of blocking for Erlang C systems.
2. Explain why Data transmissions have a significantly higher Grade of Service than Voice transmissions.

Lecture 8: Coverage and Capacity

1. Explain the difference between coverage and capacity.
2. Describe the techniques used to improve system coverage and capacity.
3. Calculate improvement in SINR or capacity based on sectoring cells.

Lecture 9: Introduction to Propagation

1. Explain the difference between large-scale and small-scale propagation.
2. Apply the Friis free-space equation to solve a variety of free-space propagation problems.

Lecture 10: Power and E-Field / Three Propagation Methods

1. Calculate power, voltage, and E-Field strength using Friis equation.
2. Describe qualitatively the three modes of electromagnetic wave propagation.

Lecture 11: Reflection and the Two-Ray Model

1. Describe the fundamental scenario for reflection of an electromagnetic wave.
2. Calculate the phase difference for the two-ray model.
3. Apply the two-ray model to find received power for a communication link.

Lecture 12: Diffraction (Knife Edge)

1. Describe the fundamental scenario for diffraction of an electromagnetic wave.
2. Normalize a knife-edge diffraction problem and calculate α, υ.
3. Determine the diffraction gain associated with the obstruction.

Lecture 13: Scattering

1. Describe conceptually how electromagnetic waves scatter from rough surfaces.
2. Calculate the received power when electromagnetic energy is scattered from a rough surface.
3. Describe log-normal fading, and explain how shadowing impacts received power.
4. Calculate received power given path loss exponent; determine path loss exponent from received power measurements.

Lecture 14: Link Budgets

1. Evaluate link budgets for various communication scenarios.
2. Use link budgets to determine various system parameters.

Lecture 15: Indoor Propagation Models

1. Use the partition-based path loss model (or one of its derivatives) to calculate received power for various scenarios.
2. Describe the advantages and weaknesses of the partition-based path loss model.
3. Describe alternatives to indoor propagation modeling.

Lecture 16: Small-Scale Fading and Multipath Impulse Response

1. Explain the causes of fading.
2. Describe the factors that influence fading
3. Explain the four types of fading and calculate which type applies to a particular scenario.
4. Describe the impact of fading on wireless communications.

Lecture 17: Parameters of Multipath Channels

1. Express the impulse response of a wireless channel both graphically and mathematically.
2. Calculate Mean Excess Delay, RMS Delay Spread, Max Excess Delay, Coherence Bandwidth, and Doppler Spread.
3. Relate the above parameters to the performance or selection of a particular wireless communication standard.

Lecture 18: Introduction to Fading

1. Describe both conceptually and mathematically the causes of fading.
2. Describe the difference between Rayleigh, Ricean, and Nakagami-m Fading.
3. Calculate Level Crossing Rate and Average Fade Duration for Rayleigh Fading.
4. Calculate Ricean K-Factor and Nakagami m-Factor.

Lecture 19: Statistical Modeling for Fading Channels

1. Explain how the Clarke and Gans model describes fading in a mobile wireless environment.
2. Calculate and draw the Doppler spectrum that results from the Clarke and Gans model.
3. Explain how the 2-Ray model improves on the Clarke and Gans model.
4. Explain conceptually how the Saleh-Valenzuela model predicts the multipath structure for a wireless channel.