Kaferelsheikh University		Faculty of Engineering
Department of Electrical Engineering		Year: 4th Electronics and
Subject: Elective course (4)		Electrical Communication
Academic Number: ECE 4227		Final Exam: 2 pages
Full Mark: 70	Date: 13/6/2021	Time allowed: 3 h

This Exam measures the LOS related to competancies [A.1, A.2, B.2, B.3 and C.3]

Answer the following questions:

[1] Question One: (15 Mark)

A- What is the theoretical value of the propagation exponent for these two cases?
   i) Free-space propagation.
   ii) Propagation over a perfect ground plane, for distances beyond the breakpoint distance.

[5 marks]

B- Explain the shadowing phenomena, then write down the equation used to model this phenomenon.

[5 marks]

C- Find the outage probability at 150 m for a channel based on the combined path loss and shadowing models if the propagation exponent is 3.71 and $K = -31.54$ dB, assuming a transmit power of $Pt = 10$ mW and minimum power requirement $Pmin = -110.5$ dBm.

[5 marks]

[2] Question Two: (20 Mark)

A- What is the relation between the radio bandwidth of a system and its capability to resolve signals that arrive with different propagation delays?

[5 marks]

B- Identify the following terms: average fade duration, coherence time and coherence bandwidth.

[5 marks]

C- Consider a channel with Rayleigh fading and average received power $Pr = 20$ dBm. Find the probability that the received power is below 10 dBm.

[5 marks]

D- Consider a voice system with acceptable BER when the received signal power is at or above half its average value. If the BER is below its acceptable level for more than 120 ms, users will turn off their phone. Find the range of Doppler values in a Rayleigh fading channel such that the average time duration when users have unacceptable voice quality is less than $t = 60$ ms.

[5 marks]

[3] Question three: (20 Mark)

A- deduce an expression for Shannon capacity in case of **Receiver CSI**. Is this capacity smaller or larger than the capacity of AWGN channel with the same average signal to noise ratio?

[7 marks]

B- Consider two different wireless systems **a** and **b**. For **a**, the signal bandwidth of the system is much smaller than the coherence bandwidth of the channel. Conversely, **b** employs a signal bandwidth that is much larger than the coherence bandwidth of the channel. Which system (**a** or **b**) is best suited for employing frequency diversity techniques? Motivate Your answer.

C- Explain the operation of linear combiner used in receiver space diversity and then analyze it to find the array gain

[4] Question four: (15 Mark)

A- i) What is the relationship between the bandwidth of a signal before and after it has been encoded using spread spectrum? [2 marks]

ii) Draw a block diagram of Frequency Hopping Spread Spectrum System and then explain the difference between slow FHSS and fast FHSS

B- An FHSS system employs a total bandwidth of $Ws = 400$ MHz and an individual channel bandwidth of 100 Hz. What is the minimum number of PN bits required for each frequency hop?

C- Explain the basic principles of OFDM and construct an illustrative diagram for the generation process. [5 marks]