Bengal Engineering & Science University, Shibpur

M.E. (ETCE) 2nd SEMESTER FINAL EXAMINATION, 2013

Wireless Communication (ETC-1041)

Full marks: 70

Time: 3 hours

Answer any **FIVE** questions

All questions carry equal marks

1. Explain the concepts of large-scale and small-scale fading in mobile wireless channel. With a fixed transmitting antenna, free space, and moving receive antenna model explain the concept of *Doppler shift*. Determine the maximum and minimum spectral frequencies received from a stationary GSM transmitter that has a carrier frequency of exactly 1950.00MHz, assuming that the receiver is travelling at speeds of (i) 1 km/kr, (ii) 60km/hr.

2. Derive a baseband equivalent model of a wireless channel having a bandwidth of W around a centre frequency of f_c. Draw necessary illustrations. Use this model to determine an input-output relationship of a wireless system in the discrete-time domain.

3. Discuss the concept of *delay spread* in a wireless channel. Explain its relation with *coherence bandwidth* of the wireless channel. What is an underspread channel? Delay spread D_s of a certain wireless channel is 0.5 μs. If BPSK modulation is used, what is the maximum bit rate that can be supported by the channel without needing an equalizer? Consider the following. When symbol duration of the input is considerably large (say 10 times) than the *delay spread*, the channel is considered as flat fading.

4. Justify the use of Rayleigh distribution for modeling slow fading wireless channels. Discuss the *bit error rate* (BER) performance of a point-to-point communication system in a Rayleigh fading channel. Plot the result and compare it with that of AWGN channel. Determine the (approximate) value of BER of a BPSK communication in a Rayleigh fading channel when the received SNR is 25 dB.

5. Explain the concept of diversity in the context of wireless communication. Discuss the types of diversity techniques used in wireless communication systems. Show that for repetition coding, at high SNR, the probability of bit error is inversely proportional to SNR^L , where L is the diversity order. Give an example of use of time diversity in practical wireless communication system.

6. Explain how transmit diversity is achieved in Alamouti's scheme. Does the idea of transmit antenna diversity exist before Almouti's scheme was published? If yes, what was his contribution? Compare two-antenna transmit diversity, two-antenna receive diversity, four-antenna receive diversity and no diversity schemes by plotting their respective BER performances in a Rayleigh fading channel.

7. Explain briefly the importance of Shannon's channel capacity theorem. Prove that in a *single input multiple (two) output channel*, received SNR is 3dB higher than a single antenna system. Assume linear time invariant channel and known it is to the receiver. Also find out the improvement in

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capacity over a than a single antenna system. "Capacity of slow fading channel in strict sense is zero". Justify the statement. Explain the concepts of outage probability and ϵ-outage capacity.

8. Write short notes on (**any two**)

    a. Receive diversity
    b. Rake receiver and frequency diversity
    c. Power allocation in OFDM communication system for maximizing system capacity