(Following Paper ID and Roll No. to be filled in your Answer Book)

PAPER ID : 0385 Roll No. ⬜⬜⬜⬜⬜⬜⬜⬜⬜

B. Tech.

(SEM. VIII) THEORY EXAMINATION 2010-11

WIRELESS COMMUNICATION

Time : 3 Hours   *Total Marks : 100*

Note : (1)   Attempt **all** questions.

(2)   Each question carries equal marks.

(3)   Assume data wherever missing.

1.   Attempt any **four** of the following :   **(4×5=20)**

(a)   Give the name and basic features of different types of radio wave propagation models. List the general steps involved in a Line of Sight (LoS) system design.

(b)   Assume a receiver is located 10 km from a 50 W transmitter. The carrier frequency is 6 GHz and free space propagation is assumed, $Gt = 1$ and $Gr = 1$.

(i)   Find the power at the receiver.

(ii) Find the magnitude of the E-field at the receiver antenna.

(c)   Suppose that, by law, a service operator is not allowed to radiate more than 30 watts of power. From the plane-Earth model, what antenna height is required for a service radius of 1 km ? 10 km ? Assume the receiver sensitivity is –100 dBm. Assume the transmitter and receiver antenna gains are 0 dB, and for a mobile service make the reasonable assumption that the mobile antenna has a height of about 1m. Can Okumura-Hata model be applied to solve this problem at 800 MHz ?

(d) What do you understand by 'Time delay spread' ? Define 'Coherence BW'. Explain small-scale fading types based on Doppler spread and coherence time.

(e) For each of the two scenarios below, decide if the received signal is best described as undergoing fast fading, slow fading, frequency selective fading, or flat fading :

    (i) A binary modulation has a data rate of 500 kbps, fc= 1 GHz and a typical urban radio channel is used.

    (ii) A binary modulation has a data rate of 5kbps, fc = 1 GHz and a typical urban radio channel is used to provide communications to cars moving on a highway.

(f) Measurements of a radio channel in the 800 MHz frequency band indicate that the coherence bandwidth is approximately 100 kHz. What is the maximum symbol rate that can be transmitted over this channel that will suffer minimal intersymbol interference ?

2. Attempt any **four** of the following : $(4 \times 5 = 20)$

(a) Draw the general model of a Frequency Hopping Spread Spectrum (FHSS) System and explain its basic concept. Differentiate between slow FHSS and fast FHSS.

(b) Consider a DSSS downlink with bandwidth expansion $N = Bs/B = 100$. Assume the system is interference-limited and there is no multipath on any user's channel. How many users can the system support under BPSK modulation such that each user has a BER less than 10^{-3} ?

(c) Sketch the transmitted DSSS signal $S(t)S_c(t)$ over two bit times $[0, 2T_b]$ assuming that $S(t)$ is BPSK modulated with carrier frequency 100 MHz and $T_s = 1$ μ sec. Assume the first data bit equals a one and the second data bit equals a zero. Also assume there are 10 chips per bit and the chips alternate between ± 1, with the first chip equal to +1.

(d) Describe adaptive equalization ? What are the factors that determine the performance of the algorithms used for adaptive equalization ?

(e) Write short notes on any **two** of the following :

   (i) Time diversity

   (ii) Frequency diversity

   (iii) Space diversity.

(f) Explain the structure of a RAKE receiver with the help of a neat block diagram.

3. Attempt any two of the following :   (2×10=20)

(a) List the significant factors which influence the choice of speech coders in mobile communication systems. Using a block diagram, explain Linear Predictive Coding (LPC) system.

(b) Write short notes on :

   (i) Adaptive quantization

   (ii) Companding

   (iii) Vector quantization.

(c) Consider a metropolitan city with a total area of 1500 km^2 to be covered by a hexagonal cellular system with 7-cell resuse pattern. Suppose each cell has a radius(R) of 5 km and the city is allocated 25 MHz of spectrum, with a full duplex channel bandwidth of 30 KHz and total 40 KHz guard bands. The system uses FDMA with 14 control channels. Determine :

   (i) The number of cells in the service area,

   (ii) The number of channels without frequency reuse,

   (iii) The cell capacity, and

   (iv) The system spectral efficiency in channels/MHz/km^2.

4. Attempt any **two** of the following : (2×10=20)

(a) What are different methods of improving geographical coverage and capacity in cellular systems ? Explain.

(b) What is the difference between cochannel interference and adjacent channel interference ? Describe different channel assignment techniques used in cellular communications. Suppose the signal-to-cochannel interference ratio in certain cellular communications situation is $S/I = 20dB$ or 100. Also, from measurements, it is found that path loss exponent $n = 4$. What is the minimum cluster size ?

(c) If $W = 1.25$ MHz, $R = 9600$ bps, and a minimum acceptable E_b/N_0 is found to be 10dB, determine the maximum number of users that can be supported in a single cell CDMA system using (a) omni directional base station antennas, (b) three sectors at the base station, and (c) six sectors at the base station. Assume the system is interference limited.

5. Attempt any **two** of the following : (2×10=20)

(a) Compare the different second generation mobile communication systems, particularly in terms of multiple access technologies used, modulation techniques, and channel BW.

(b) Describe Bluetooth and WLL.

(c) Write short notes on any **two** of the following :

(i) GSM

(ii) 3G Wireless Networks

(iii) UMTS.