

Ref: Ex/ET/T/422/2017 (Old)

BETCE 4th Year second Semester, 2017
Satellite, Mobile and Personal Communication

Time: 3 hours

Full Marks-100

Answer Q1 and any four from the rest
Answer must be written at one place for each attempted questions

Q1 A. Fill in the blanks: 1x10 =10

- a. Multiple access technology is meant for _____ transmission?
- b. CDMA is the targeted access technology for _____ networks.
- c. For TDMA system spectrum overlap is avoided by applying _____.
- d. For FDMA access non-linearity of power devices generates _____.
- e. For TDMA the channel time is partitioned into _____.
- f. Guard times are required in TDMA because to allow _____ in reception in between different users.
- g. For WTDMA user is allowed to use _____ to transmit information in the assigned slots.
- h. The principle of spread spectrum communications is that the bandwidth of the base band signals from the different users is spread by different signals bandwidth _____ than the base band signal.
- i. CDMA is _____ limited, whereas FDMA is _____ limited.
- j. Signal separation in CDMA BSs is done by _____ of the codes.

Q1B. Solve the problems 5x2=10

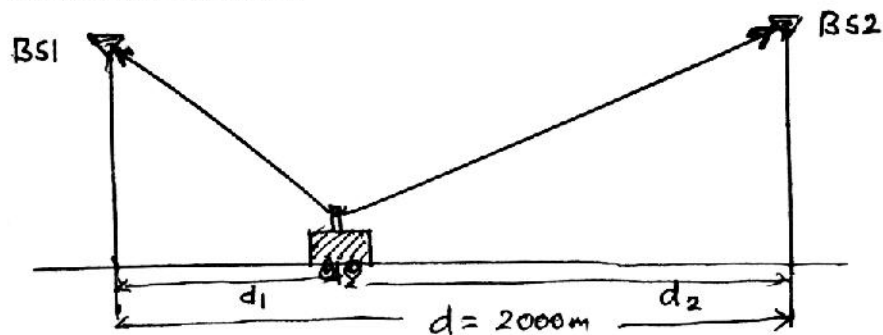
i) With respect to the following figure, the received signal power in dBm at the base station "i" is modeled by the path loss log-distance model as,

$$P_{r,i}(d_i) = P_0 - 10 k \log_{10} (d_i/d_0) \text{ dBm}$$

Where d_i = distance between the mobile and the BS i , $i=1,2$, P_0 = received signal at reference distance $d_0 = 1\text{m}$, $P_0 = 0 \text{ dBm}$, and $k = 3$, Assume minimum signal level for successful communication at BS receiver is $P_{r,\text{min}} = -88 \text{ dBm}$. $P_{r,\text{HO}}$ is the threshold for handoff initiation. Mobile is currently attached to BS₁ and moving towards BS₂, time required to compute handoff with BS₂ is 4.5 Sec. Determine minimum required margin of handoff $\Delta = P_{r,\text{HO}} - P_r$,

[Turn over

\min to assume call would not be lost due to handoff. What would be the maximum velocity limit of the mobile for successful handoff?



ii)) If a signal-to-interference ratio of 15 dB is required for satisfying forward channel performance of a cellular system, what is the frequency reuse ratio (q) and cluster size (N) that should be used for maximum capacity if path loss exponent $k=4$ and 3. Assume that there are six co-channel cells in the first tier and the mobile is residing at the cell corner position. Comment on the results.

Q2. a) Show that in a multipath wireless propagation environment the envelop of received signal at the mobile receiver follows Rayleigh pdf.

For a Rayleigh fading channel with $\sigma = .001$, what would be the probability that a received signal would exceed a threshold voltage of 5 mV? Write only expression. 5+2

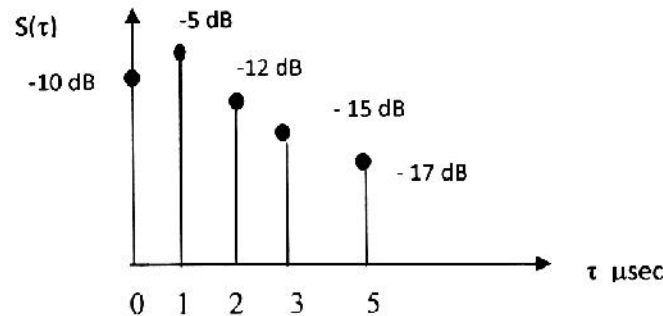
b) Now imagine in problem (a), there is only one strong direct component of amplitude A volt present in the multipath along with other NLOS components, how would the envelop of the received signal be changed and represented? Will the probability of the detection increase for the same threshold voltage of 5 mV as in (1)? Justify your answer. 04

c) Find the outage probability of a Rayleigh channel if the average power is equal to $3\mu\text{W}$ and the minimum threshold is $1\mu\text{W}$. What would be the outage probability if threshold $P_{th} = 2\mu\text{W}$? Comment on the results. 06

c) Define Rician factor K and write its significance. 03

Q3. a) Find the relationship of power delay profile with the maximum delay spread and rms delay spread in multipath propagation. 05

b) The discrete power profile delay for multipath transmission is shown in figure below, show the multipath power gain, mean delay and rms delay spread. What would be the maximum transmission rate that would be supported by the system with the found rms delay?



08

c) Establish the relationship between Doppler power spectrum, coherence time and coherence bandwidth with pictorial representation and write their significance. 07

Q4. a) Mobility management in cellular communication is very challenging and consists of two parts as Location management and handoff management. Explain the two operations clearly with pictorial representation. With respect to these operations define the terms, registration update, paging, hard and soft handoff, handoff margin. 12

b) A receiver in an urban cellular radio system detects a 1 mW signal at $d_0 = 1$ meter from the transmitter. In order to mitigate co-channel interference effects, it is required that the signal received at any base station receiver from another base station transmitter which operates with the same channel must be below -100 dBm. A measurement team has determined that the average path loss exponent in the system is $k=3$. Determine the major cell radius R of each cell if a 7-cell reuse pattern is used. (Consider the log-distance path loss model). 08

Q5.a) Explain GSM cellular networks multiple access technique. What is the uplink and downlink frequency range for GSM. What is the frequency spacing for each channel in GSM. What is called burst? 09

b) Draw the GSM signaling protocols layers between mobile handset, BSS and MSC. 05

c) Explain the functionalities of BTS, BSC and MSC with respect to GSM cellular communication. 06

Q6. a) Unlike the FDMA, TDMA systems, the spectral efficiency of CDMA system is defined differently under the constraint of $(E_b/I_o)_{th}$ – explain. 08

b) A CDMA system is defined with the following parameters:

Frequency reuse efficiency $\eta_f = 0.6$, $E_b/N_0 = 12$ dB, information bit transmission rate 16.2 kbps, system bandwidth 12.5 MHz. Neglecting all other sources of interference, determine the system capacity and spectral efficiency of the CDMA system. 07

c) Write in which cellular wireless systems, the following access techniques are used:

FDMA/FDD, TDMA/FDD, FDMA/TDD, CDMA/FDD, CDMA/TDD 05

Q7. a) Explain how GEO mode of satellite communication helps to cover large land area in a country as well as offshore locations simultaneously. What are the other two non-GEO satellites? 07

b) With pictorial representation, explain the problem of microwave and optical communication over satellite communication. Mention 3 most advantages of satellite communication. 06

c) What is called attitude of a satellite and why does attitude control require? What is the biggest cost for orbit control of satellite? 04

d) Draw the satellite transponder system at 6/4 GHz link. Why satellite antenna need to be highly directional. 03

Q8. a) Explain how GPRS and EDGE network evolves from GSM network. What is the unique feature of these networks. Give the data rate from EDGE and GPRS. 08

b) For every session over GPRS network, PDP context is a must- why and how PDP context is created. 08

c) In which nodes of GPRS network G_b and G_n interface (protocol) work? 04