Master of E. & Tel. E. Examination, 2018

(Second Semester)

Wireless & Mobile Communication Systems

Time: Three hours **Full Marks: 100**

Answer any **five** questions

Answer must be written **at one place** for each attempted question

Q1. a) How are locations of co-channel cells determined in a cellular system, explain with pictorial representation. What are the possible cluster sizes in cellular networks?

b) How is signal to interference ratio (S/I) related with frequency reuse ratio 'q' for omni directional antenna use? Show that S/I ratio plays role in the design of cell cluster.

c) Derive the expression for S/I ratio in a worst-case scenario while a mobile node resides at the corner of a cell for 120^0 and 60^0.

d) Determine the minimum frequency reuse factors for no sectoring, 120^0 sectoring and 60^0 sectoring, respectively, taking into consideration that S/I value of 18 dB or better is satisfactory. 4x5=20

Q2. a) Define the location area and paging area in a cellular communication network.

Justify that if location area size decreases then cost of handoff management may increase.

b) What are the various methods of **prioritizing the handoff**? Prioritization of handoff calls control grade of services GOS – How?

c) Defining probability of call blocking and forced termination, find the traffic utilization of a network. 6+7+7

Q3. a) What is the difference between the Log-distance path loss model and Log-normal shadowing? When these two models are used?

b) The received signal in an pico cellular environment is found to be satisfied the log-normal distribution as $P_r(d) \propto d^{-3.5}$. At a reference distance $d_0 = 1m$ from the base transmitter, the received signal is 1mW. At a distance of 10 m, it is found that 9.9% of the measurements were stronger than the –30 dBm.

Find the standard deviation σ, for the path loss model at a distance d=10m, find your result in terms of Q function.

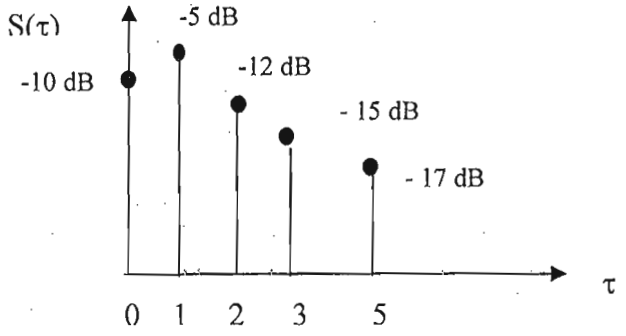
c) In a wireless multipath channel, consider two pulses are transmitted having equal amplitude at a time gap of T sec. With pictorial representation explain the effect on received pulses.

d) The "multipath delay" spread causes time dispersion and frequency selective fading and the "Doppler spread" leads to frequency dispersion and time selective spreading – explain the statements in terms of different fading phenomena. 5+6+3+6

Q4. a) There are four channel functions for wireless LTV channel: write the expressions for them and the correlation between the four channels.

b) For a WSS wireless channel response, show that Correlation $\phi_h(\tau_1, \tau_2, \Delta t)$ represents the delay power spectral density. What will be the frequency domain representation of $\phi_h(\tau_1, \tau_2, \Delta t)$? From these two functions define the coherence time and coherence bandwidth.

c) 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? 6+8 +6



Q5. a) Highlight the purpose of equalization and diversity techniques?
With block diagram of a complete communication system, establish the concept of equalization by showing that equalization is the filter with inverse channel response. What will happen if the channel is frequency selective? 4+5+1

b) Show that adaptive equalization with MMSE process using LMS algorithm the weight adaptation follow the Winer-Hopf equation. 10

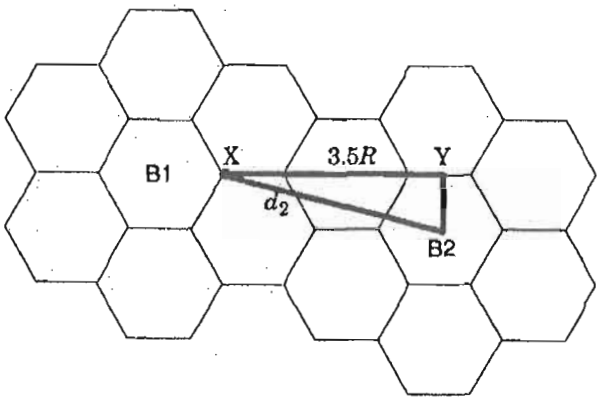
Q6. a) By drawing the GPRS cellular network architecture, explain the data communication process between a mobile residing within GPRS and a device within an external PDN.
Now consider the mobile is roaming within GPRS network, then how does data from PDN correctly delivered to the mobile? 5+4

b) Explain the evolutionary process of physical layer issues from GSM-GPRS-EDGE-UMTS-LTE to support voice to multimedia communication. 07
c) What are the key features of LTE? 04

Q7. a) What does Wi-Fi stand for? Provide a tabular representation of 802.11a, b and g family in terms of frequency band, throughput, modulation technique and multiplexing technique used. 2+4
b) Describe the WLAN transmission technologies generally used.
What are the hidden node problem and exposed node problem in a wireless LAN? How do they overcome using MAC protocols? 5+5
c) What is called Bluetooth communication? What are the operating range of Bluetooth for frequency, distance and throughput? 04

Q8. a) Cell B1 is the desired cell and B2 is a co-channel cell as shown in Figure below. For a mobile located in cell B1, find the minimum cell radius R to give a forward link C/I ratio of at least 18 dB. Assume the following:
Co-channel interference is due to base station B2 only. Carrier frequency, f_c = 900 MHz. Reference distance, d_0 = 1 km (assume free space propagation from the transmitter to destination d_0). Assume omni-directional antennas for both transmitter and receiver where gain, G_{BS} = 6 dBi and G_{MS} = 3 dBi, Transmitter power = 10 W (assume equal power for all base stations). Table for Q f^n is attached at the end. 12

PL(dB) between the mobile and base station B1 is given as
$PL(dB) = PL(d_0) + 10(2.5)\log_{10}(d_1/d_0) - X\sigma$, σ = 0 dB
PL(dB) between the mobile and base station B2 is given as
$P_L'(dB) = P_L'(d_0) + 10(2.5)\log_{10}(d_2/d_0) - X_\sigma$, $\sigma = 7$ dB



b) A receiver in an urban cellular radio system detects a 1 mW signal at d0 = 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

Table 1 *Tabulation of the Q-function*

z	Q(z)	z	Q(z)
0.0	0.50000	2.0	0.02275
0.1	0.46017	2.1	0.01786
0.2	0.42074	2.2	0.01390
0.3	0.38209	2.3	0.01072
0.4	0.34458	2.4	0.00820
0.5	0.30854	2.5	0.00621
0.6	0.27425	2.6	0.00466
0.7	0.24196	2.7	0.00347
0.8	0.21186	2.8	0.00256
0.9	0.18406	2.9	0.00187
1.0	0.15866	3.0	0.00135
1.1	0.13567	3.1	0.00097
1.2	0.11507	3.2	0.00069
1.3	0.09680	3.3	0.00048
1.4	0.08076	3.4	0.00034
1.5	0.06681	3.5	0.00023
1.6	0.05480	3.6	0.00016
1.7	0.04457	3.7	0.00011
1.8	0.03593	3.8	0.00007
1.9	0.02872	3.9	0.00005