Course: Wireless Communications		Number: 464/2	Section: U
Examination: Final	Date: Dec. 12, 2009	Time: 3 Hours	# of pages: 3
Instructor: Dr. M.R. Soleymani			
Books and Materials: Only two crib sheets are allowed			
Calculator: Allowed (standard type)			
Special instructions: Try all 8 questions. Make reasonable assumptions if necessary.			

1) a) A cellular system uses seven-cell frequency re-use. The total number of channels available is 210. Two channels in each cell are used as control channels. Subscribers are divided into three groups. The percentage of each group and the number of calls generate per day is shown in Figure 1. If the average duration of a call is 3 minutes and a GOS of 0.005 is required find the number of subscribers that each cell can support (7 Marks).

Group	Percent	Calls/day
1	20%	50
2	30%	30
3	50%	10

Table 1: Distribution of users and their calling habit

b) What is the total number of customers that the system can support if the area of the city is 400 square km. and the cell radius is 1.5 km. (3 Marks)

2) A transmitter has an EIRP of 24 dBW and operates at a frequency of 900 MHz. The receiver is 20 km away from the transmitter and has an antenna with a gain of 4 dB. The receiver has a bandwidth of 100 kHz and a noise figure of 6 dB. Find the probability that the signal-to-noise-ratio is less than 15 dB. Assume a log-normal propagation model with $n = 4, \sigma = 10$ and $d_0 = 1$ km (8 marks.)

3) a) Use the primitive polynomial $p(x) = x^4 + x + 1$ to generate the elements of $GF(16)$ (4 Marks).
b) Find the generating polynomial of the single error correcting RS code over GF(16) (3 Marks).

4) A communication system uses TDMA with eight time slots per frame. The number of bits per time slot is 1500 and the frame duration is 4ms. The system uses QPSK modulation with square-root raised cosine filtering with $\alpha = 0.3$ and a (63, 59) RS code over GF(64) over an AWGN channel with $\frac{E_b}{N_0} = 8$ dB.

a) Find the total bit rate and the bit rate of each user (2 Marks).
b) Find the total required bandwidth (2 Marks).
c) Find the bit error probability (4 Marks).

5) In a CDMA system, the chip rate is 1.3 Mcps and the user information rate is 10 kbps. Thermal SNR, $E_b / N_0 = 16\ dB$.

a) Find the maximum number of users if it is required that the BER does not exceed 10^{-3} (4 marks.)

b) Repeat part (a) considering voice activity monitoring with $\alpha = 0.4$ and 120° sectoring (2 Marks).

6) In a selection diversity scheme, the average SNR for each branch is 25 dB.

a) Find the number of branches needed if we require that the probability that the falls below 15 dB does not exceed 10^{-6} (5 marks).

b) How many branches are required if maximal ratio combining is used (3 marks)?

c) Find the average overall signal to noise ratio for both cases (2 Marks).

7) A mobile traveling at a speed of 50 km. per Hour transmits at a rate of 2 Mbps in the1800 MHz. band. How often does the equalizer need to be updated (4 Marks)? How many bits can be transmitted between two updates (2 Marks)?

8) The power delay profile of a multipath fading channel is shown in Figure 1. A mobile transmits at a rate of 1 Mbps using QPSK with a raised cosine filter with rolloff factor of $\alpha = 0.3$ over this channel. Can the channel be considered flat fading (5 Marks)?

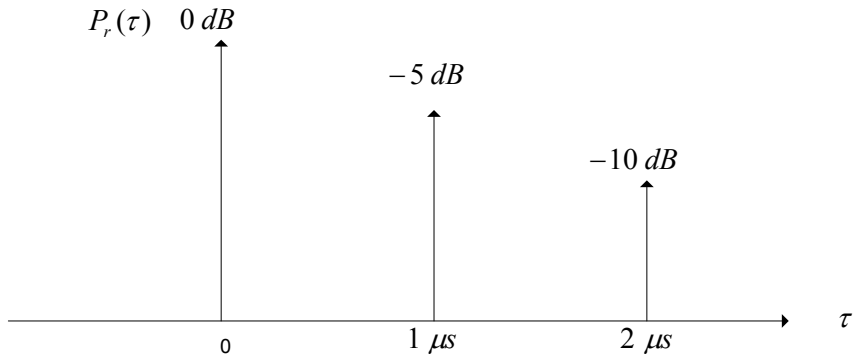

Figure 1

B in Percent

N/B	0.01	0.05	0.1	0.5	1.0	2.0	5.0
1	.00010	.00050	.00100	.00503	.01010	.02041	.05263
2	.01425	.03213	.04576	.10540	.15259	.22347	.38132
3	.08683	.15170	.19384	.34900	.45549	.60221	.89940
4	.23471	.36236	.43927	.70120	.86942	1.0923	1.5246
5	.45195	.64857	.76212	1.1320	1.3608	1.6571	2.2185
6	.72826	.99567	1.1459	1.6218	1.9090	2.2759	2.9603
7	1.0541	1.3922	1.5786	2.1575	2.5009	2.9354	3.7378
8	1.4219	1.8298	2.0513	2.7299	3.1276	3.6271	4.5430
9	1.8256	2.3016	2.5575	3.3326	3.7825	4.3447	5.3702
10	2.2601	2.8028	3.0920	3.9607	4.4612	5.0840	6.2157
11	2.7216	3.3294	3.6511	4.6104	5.1599	5.8415	7.0764
12	3.2072	3.8781	4.2314	5.2789	5.8760	6.6147	7.9501
13	3.7136	4.4465	4.8306	5.9638	6.6072	7.4015	8.8349
14	4.2388	5.0324	5.4464	6.6632	7.3517	8.2003	9.7295
15	4.7812	5.6339	6.0772	7.3755	8.1080	9.0096	10.633
16	5.3390	6.2496	6.7215	8.0995	8.8750	9.8284	11.544
17	5.9110	6.8782	7.3781	8.8340	9.6516	10.656	12.461
18	6.4959	7.5186	8.0459	9.5780	10.437	11.491	13.385
19	7.0927	8.1698	8.7239	10.331	11.230	12.333	14.315
20	7.7005	8.8310	9.4115	11.092	12.031	13.182	15.249
21	8.3186	9.5014	10.108	11.860	12.838	14.036	16.189
22	8.9462	10.180	10.812	12.635	13.651	14.896	17.132
23	9.5826	10.868	11.524	13.416	14.470	15.761	18.080
24	10.227	11.562	12.243	14.204	15.295	16.631	19.031
25	10.880	12.264	12.969	14.997	16.125	17.505	19.985
26	11.540	12.972	13.701	15.795	16.959	18.383	20.943
27	12.207	13.686	14.439	16.598	17.797	19.265	21.904
28	12.880	14.406	15.182	17.406	18.640	20.150	22.867
29	13.560	15.132	15.930	18.218	19.487	21.039	23.833
30	14.246	15.863	16.684	19.034	20.337	21.932	24.802
31	14.937	16.599	17.442	19.854	21.191	22.827	25.773
32	15.633	17.340	18.205	20.678	22.048	23.725	26.746
33	16.335	18.085	18.972	21.505	22.909	24.626	27.721
34	17.041	18.835	19.743	22.336	23.772	25.529	28.698
35	17.752	19.589	20.517	23.169	24.638	26.435	29.677

Maximum offered load versus Blocking Probability (B) and the Number of Channels (N)