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Question Paper Code : 27204

B.E./B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2015.

Fifth Semester

Information Technology

EC 6801 — WIRELESS COMMUNICATION

(Regulations 2013)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Find the far-field distance for an antenna with maximum dimension of 2 m and operating frequency of 1 GHz.

2. Define Coherence time and Coherence bandwidth.

3. Define Co-channel reuse ratio.

4. Define Grade of Service.

5. Find the 3-dB bandwidth for a Gaussian low pass filter used to produce 0.25 GMSK with a channel data rate of R_b = 300 kbps.

6. An 900 MHz carrier signal is frequency modulated using a 100 kHz sinusoidal modulating waveform. The peak deviation of the FM signal is 500 kHz. If this FM signal is received by a superheterodyne receiver having an IF frequency of 5 MHz, determine the IF bandwidth necessary to pass the signal.

7. If a digital signal processing chip can perform one million multiplications per second, determine the time required between each iteration for the following adaptive equalizer algorithms.

   (a) Square root RLS DFE

   (b) Gradient lattice DFE

8. Draw the structure of a linear transversal equalizer.

9. What is Antenna Diversity?

10. Write down the expressions for probability of error for BPSK modulation techniques, with coherent detection for the following cases,

(a) AWGN

(b) Rayleigh Fading.

PART B — (5 × 16 = 80 marks)

11. (a) (i) Explain the advantages and disadvantages of the two-ray ground reflection model in the analysis of path loss. (4)

(ii) In the following cases, tell whether the two-ray model could be applied, and justify why or why not :

Case (i) : $h_1 = 35$ m, $h_r = 3$ m, $d = 250$ m

Case (ii) : $h_1 = 30$ m, $h_r = 1.5$ m, $d = 450$ m (6)

(iii) Prove that in the two-ray ground reflected model, $\Delta = d'' - d' = 2h_t h_r / d$. (6)

Or

(b) Derive the Impulse response model of a multipath channel and also obtain the relationship between Bandwidth and Received power.

12. (a) (i) A cellular service provider decides to use a digital TDMA scheme which can tolerate a signal-to-interference ratio of 15 dB in the worst case. Find the optimal value of N for

(1) Omnidirectional antennas (3)

(2) 120° sectoring (3)

(3) 60° sectoring. (3)

(4) Should sectoring be used? If so, which case (60° or 120°) should be used? (Assume a path loss exponent of $n = 4$ and consider trunking efficiency.) (3)

(ii) If a signal-to-interference ratio of 15 dB is required for satisfactory forward channel performance of a cellular system, what is the frequency reuse factor and cluster size that should be used for maximum capacity if the path loss exponent is (1) $n = 4$, (2) $n = 3$? (4)

Or

(b) A hexagonal cell within a four – cell system has a radius of 1.387 km. A total of 60 channels are used within the entire system. If the load per user is 0.029 Erlangs, and $\lambda = 1$ call/hour, Compute the following for an Erlang C system that has a 5% probability of a delayed call :

(i) How many users per square kilometer will this system support?

(ii) What is the probability that a delayed call will have to wait for more than 10 sec?

(iii) What is the probability that a call will be delayed for more than 10 sec?

[Data : From Erlang C chart, for 5% probability of delay with C = 15, traffic intensity = 9.0 Erlangs.]

13. (a) (i) Explain in detail about Gaussian Minimum Shift Keying (GMSK) Transmission and Reception with necessary block diagrams. (10)

(ii) A zero mean sinusoidal message is applied to a transmitter that radiates an AM signal with 10 kW power. Compute the carrier power if the modulation index is 0.6. What percentage of the total power is in the carrier? Calculate the power in each sideband. (6)

Or

(b) Derive the expression for MSK signal as a special type of continuous phase FSK signal. (16)

14. (a) Consider a single branch Rayleigh fading signal has a 20% chance of being 6dB below some mean SNR threshold.

(i) Determine the mean of the Rayleigh fading signal as referenced to the threshold. (5)

(ii) Find the likelihood that a two branch selection diversity receiver will be 6 dB below the mean SNR threshold. (2)

(iii) Find the likelihood that a three branch selection diversity receiver will be 6 dB below the mean SNR threshold. (2)

(iv) Find the likelihood that a four branch selection diversity receiver will be 6 dB below the mean SNR threshold. (2)

(v) Based on your answers above, is there a law of diminishing returns when diversity is used? (5)

Or

(b) Derive the mean square error for a Generic Adaptive Equalizer.

15. (a) Determine the capacity of frequency selective fading channel and explain the concept of waterfilling/waterpouring.

Or

(b) Determine the capacity of slow fading channel and prove that the outage probability for receive diversity system with L receive antennas is $P_{out}(R) = \frac{\left(2^R - 1\right)^L}{L! SNR^L}$, where R is the data rate.