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Question Paper Code : 30539

B.E./B.Tech. DEGREE EXAMINATIONS, NOVEMBER/DECEMBER 2024.

Sixth Semester

Electronics and Communication Engineering

EC 8652 — WIRELESS COMMUNICATION

(Common to : Computer and Communication Engineering/Electronics and Telecommunication Engineering)

(Regulations 2017)

Time : Three hours — Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Define Coherence bandwidth and Coherence time.

2. The power delay profile of a wireless channel is shown in Figure 1. Determine the mean excess delay spread and RMS delay spread.

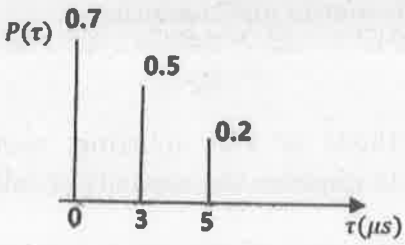

Figure 1

3. What is meant by handoff? Mention the types of handoff used in a cellular system.

4. In a cellular system with cluster size as 12 and the number of co-channel cells in the first tier as 6, determine the co-channel reuse ratio and signal-to-noise interference ratio, assuming path loss exponent as 4.

5. What is Gaussian Minimum Shift Keying? Give its application.

6. Find the number of OFDM symbols in a time slot of 2.0 milliseconds for the subcarrier spacing of 10 kHz and Guard Interval/CP of 33 μs.

7. Differentiate between microdiversity and macrodiversity.

8. What is Rake receiver? Where is it used?

9. What are the advantages of MIMO system over SISO system?

10. What is beam forming? How does it improve the performance of a wireless system?

PART B — (5 × 13 = 65 marks)

11. (a) Illustrate the small scale fading effects in a wireless channel and hence show how the channel is classified as (i) Flat fading (ii) Frequency selective fading (iii) Slow fading and (iv) Fast fading channel. (13)

Or

(b) (i) Discuss the large scale fading effects in a wireless channel and hence derive the expression for the received signal power using free space propagation model. (10)

(ii) A transmitter radiates 100 W of power using a unity gain antenna with a 900 MHz carrier frequency. The unity gain receiver antenna is at a free space distance of 100 m from the transmitter antenna. Find the received power in dBm at the receiver antenna and the Path loss in dB. (3)

12. (a) Explain the various multiple access techniques used in cellular systems and compare their merits and demerits. (13)

Or

(b) Explain the methods of cell splitting, sectoring and coverage zone approaches used to improve the capacity of cellular systems. (13)

13. (a) (i) Exemplify the transmitter and receiver architectures of OFDM system with a neat block diagram. (8)

(ii) Discuss the effect of PAPR in OFDM system and methods used to overcome PAPR. (5)

Or

(b) Illustrate the principle of Offset-QPSK and Pi/4-DQPSK modulation techniques with constellation diagram and necessary waveforms. (13)

14. (a) Explain the various Diversity Combining Techniques used in wireless systems and compare their performances. (13)

Or

(b) Derive the expression for error probability in fading channels with diversity reception techniques. (13)

15. (a) Derive the expression for capacity of a MIMO system in fading and non-fading channels. (13)

Or

(b) (i) Explain the process of spatial multiplexing using MIMO system and show it enhances the capacity of the system. (8)

(ii) Explain the significance of channel state information and show how it is determined in a MIMO system. (5)

PART C — (1 × 15 = 15 marks)

16. (a) (i) Consider a 2-Ray Ground Reflection model shown in Figure 2. Derive the expression for the total electric field E_{TOT} and the received power P_r at a distance d from the transmitter. (8)

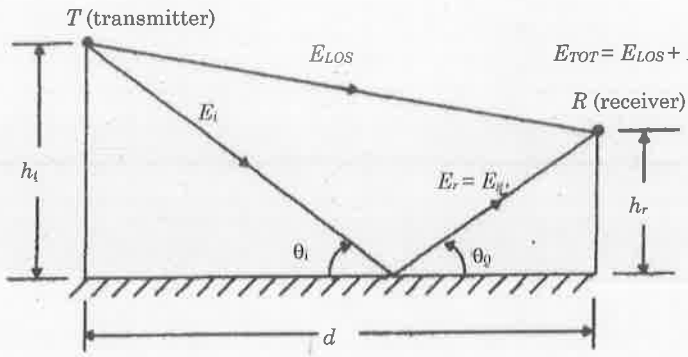

Figure 2

(ii) A vertical λ/2 dipole antenna is used at a mobile terminal (receiver) with a gain of 3 dB and it receives a carrier frequency of 1 GHz. Mobile terminal is located at a distance of 10 km from the transmitter antenna. The E-field at 2 km from the transmitter antenna is measured to be 10^{-3} V/m. The height of transmitter antenna is 100 m and that of receiver antenna is 2 m above ground. Assume a 2-Ray Ground reflection model. Determine the following:

(1) The physical length of the receiver antenna (2)

(2) The effective aperture of the antenna (2)

(3) The E-field at receiver antenna (1)

(4) The power received by the receiver antenna. (1)

(5) Path loss in dB, if the transmitted power is 1mW. (1)

Or

(b) Consider an Alamouti-coded 2×2 MIMO system with total transmit power P and noise variance σ^2 with i.i.d. noise samples across antenna and time.

(i) Illustrate the encoding and decoding process using BPSK symbol transmission. (10)

(ii) Derive the expression for the capacity of the system. (5)
