Unit 3 - Wireless Propagation and Cellular Concepts

Course outline

How to access the portal

Overview of Cellular Evolution and Wireless Technologies

Wireless Propagation and Cellular Concepts

- Lec 5: Basic Cellular Terminology
- Lec 6: Introduction to Antennas and Propagation Models
- Lec 7: Link budget, Fading margin, Outage
- Lec 8: Cellular Concept
- Lec 9: Cellular system design and analysis
- Matlab basics
- Lec5_notes
- Lec6_notes
- Lec7_notes
- Lec8_notes
- Lec9_notes
- Week 2 Feedback : Introduction to Wireless and Cellular Communications
- Assignment 2 Solutions
- Quiz : Assignment 2

Cellular System Design, Capacity, Handoff, and Outage

Week 4 - Multipath Fading Environment

Week 5 - BER Performance in Fading Channels

Week 6 - Wide Sense Stationary Uncorrelated Scattering (WSSUS) Channel Model

Week 7 - Computer simulation of Rayleigh fading, Antenna Diversity and Capacity

Week 8 - Fading Channels - Diversity and Capacity

Week 9 - Capacity and Introduction to CDMA

Week 10 - Introduction to CDMA

Week 11 - CDMA Receivers

Week 12

Text Transcription

DOWNLOAD VIDEOS

Assignment 2

The due date for submitting this assignment has passed. Due on 2019-08-21, 23:59 IST.
As per our records you have not submitted this assignment.

1) In the lectures, the uplink and downlink frequency bands of different systems were discussed. For a GSM system, the channel bandwidth is 200 KHz. The downlink frequency is at 940 MHz, then the uplink frequency should be at *1 point*

- 985 MHz
- 910 MHz
- 895 MHz
- None of the above

No, the answer is incorrect.
Score: 0
Accepted Answers:
895 MHz

2) An isotropic antenna is radiating at a frequency of 9MHz. What is the free space path loss at a distance of 4 kms from the transmitter antenna? *1 point*

- 54.7 dB
- 54.7 dBW
- 61.5 dB
- 63.6 dB

No, the answer is incorrect.
Score: 0
Accepted Answers:
63.6 dB

3) Assuming Free space propagation model, If the transmit power is 100 mW and the received power is 10^{-9} mW, what is the distance between the transmitter and the receiver. The carrier frequency is 900 MHz. *1 point*

- 26.54 km
- 8.39 km
- 3.16 km
- 0.265 km

No, the answer is incorrect.
Score: 0
Accepted Answers:
8.39 km

4) Assuming Free Space propagation model, the transmit power is 100 mW and the received power is 10^{-4}mW. What is the carrier frequency if the distance between the transmitter and the receiver antennas is 3 km? *1 point*

- 561.5 MHz
- 265.3 MHz
- 795.8 MHz
- 144.7 MHz

No, the answer is incorrect.
Score: 0
Accepted Answers:
795.8 MHz

5) The received power at the receiver is -90 dBm. The distance between the receiver and transmitter is 4 kms and the wavelength of propagation is 0.5 meters. Assuming the free space propagation model, what is the transmitted signal power? *1 point*

- 10 dB
- 10 dBm
- 5 dBW
- 5 dBm

No, the answer is incorrect.
Score: 0
Accepted Answers:
10 dBm

6) Consider a transmitter antenna. The output power of the transmitter amplifier is 20 W and the transmit antenna gain is 14 dB. The feeder attenuation is 5 dB. What is the EIRP (Equivalent Isotropic Radiated Power)? *1 point*

- 32 dBW
- 32 dB
- 22 dBW
- 22 dB

No, the answer is incorrect.
Score: 0
Accepted Answers:
22 dBW

7) IEEE 802.11a (WLAN standard) uses 64 QAM modulation to achieve a data rate of 54 Mbps. Suppose an Eb/N0 = 33 dB is required to achieve the target BER of 10^{-6}. For this data rate, what is the sensitivity of the receiver, if the noise figure = 8 dB. *1 point*

- -85.7 dBW
- -67.3 dBm
- -93.5 dBW
- -75.4 dBm

No, the answer is incorrect.
Score: 0
Accepted Answers:
-85.7 dBW

8) IEEE 802.11a (WLAN standard) uses 64 QAM modulation to achieve a data rate of 54 Mbps. Suppose an Eb/N0 = 33 dB is required to achieve the target BER of 10^{-6}. For this data rate, what is the sensitivity of receiver, if receiver has implementation loss of 4 dB and noise figure of 8 dB? *1 point*

- -81.7 dBm
- -47.7 dBm
- -33.7 dBm
- -51.7 dBm

No, the answer is incorrect.
Score: 0
Accepted Answers:
-51.7 dBm

9) An ultra-wideband (UWB) radio system transmits at a power level of 1 mW using a BW of 1 GHz. Assume that the transmitted power is uniformly spread over the utilized BW and that the UWB transmitter is at a distance of 40 m from a cellular phone. Evaluate if the interference spectral density (Watts/Hz) caused by the UWB transmitter to a cellular phone with NF = 8 dB is higher/lower than the Thermal Noise floor (N0). Assume that UWB spectrum overlaps cellular band & isotropic antennas are used & free space propagation model can be applied. Carrier frequency = 1.5 GHz *1 point*

- Noise spectral density is stronger than Interference spectral density by 8 dB
- Interference spectral density is stronger than noise spectral density by 8 dB
- Noise spectral density is stronger than Interference spectral density by 12 dB
- Insufficient information to compare the two spectral densities

No, the answer is incorrect.
Score: 0
Accepted Answers:
Interference spectral density is stronger than noise spectral density by 8 dB

10) Assuming Break-point propagation model, calculate the range over which signal can be transmitted securely when the total path loss available is 150 dB. *1 point*

Carrier frequency is 900 MHz and breakpoint dbreak = 100 meters. Path loss exponent is n = 3.5.

- 30 km
- 23.7 km
- 17.5 km
- 8.8 km

No, the answer is incorrect.
Score: 0
Accepted Answers:
17.5 km

11) In the lectures, gain of a parabolic antenna was defined. Find the gain of a parabolic antenna with radius 2 meters and efficiency factor $\eta = 0.7$. The carrier frequency is 900 MHz. *1 point*

- 36.28 dBi
- 22.68 dBi
- 29.98 dBi
- 25.78 dBi

No, the answer is incorrect.
Score: 0
Accepted Answers:
29.98 dBi

12) Consider a cascaded system consisting of three amplifiers blocks at the receiver. The gain and noise figures of the three blocks are described below. *1 point*
G1 = 10 dB G2 = 20 dB G3 = 50 dB
F1 = 2 dB F2 = 10 dB F3 = 10 dB
Find the overall Noise figure Foverall of the cascaded system

- 2.49 dB
- 3.97 dB
- 4.76 dB
- 2.95 dB

No, the answer is incorrect.
Score: 0
Accepted Answers:
3.97 dB

13) Let's say two towers A and B are "d" meter apart with tower A transmitting thrice as much power as B. There is a user connected to tower A moving towards tower B. Find the distance from Tower B when the user observes 0 dB Signal to Interference ratio. Consider free space propagation i.e the path loss exponent = 2. *1 point*

- 0.63d
- 0.25d
- 0.37d
- 0.75d

No, the answer is incorrect.
Score: 0
Accepted Answers:
0.37d

14) In a city, cell planning is done with clusters of size 7. There are 100 channels available per cell. Each cluster covers 4 sq.km area. If the city spans over 100 sq.km then calculate the capacity of the designed cellular system. *1 point*

- 28000
- 7000
- 14000
- 17500

No, the answer is incorrect.
Score: 0
Accepted Answers:
17500

For questions 15 to 20 use the information described below. Consider a cellular network built with 7-cell clusters, as described in the lectures. There is no interference across cells within a cluster, as two cells in a cluster do not share the same channel. However, there is interference from neighbouring clusters that use the same set of carrier frequencies but in a fashion that minimizes the maximum interference between two cells that use the same frequency (Co-channel cells). Assume that the Base Station transmits at 1W power and a Free-Space-Path-loss model: $\left(\frac{\lambda_{wl}}{4\pi}\right)^2$, R = 1km and Carrier frequency = 2.4 MHz (for the channel of interest) Do not approximate unless stated otherwise, for Q15-20.

15) What is the co-channel reuse ratio for the cellular network? *1 point*

- 5.29
- 4.24
- 4.58
- 3.46

No, the answer is incorrect.
Score: 0
Accepted Answers:
4.58

16) For the 'worst case' SIR due to only Tier-1 interferers, calculate the distance between user and the strongest interfering base station *1 point*

- 4.36 km
- 3.61 km
- 5.29 km
- 2.83 km

No, the answer is incorrect.
Score: 0
Accepted Answers:
3.61 km

17) Calculate the 'worst-case' SIR due to only Tier-1 interferers, without any approximations. *1 point*
Hint: Use a slightly different (u,v) coordinate system from the one described in class.

- 4.67 dB
- 5.44 dB
- 5.12 dB
- Insufficient information

No, the answer is incorrect.
Score: 0
Accepted Answers:
5.12 dB

18) What will be the 'worst-case' Tier-1 SIR if the path loss exponent increases to 4? Again, choose the closest answer. *1 point*

- 18.66 dB
- 17.68 dB
- 20.17 dB
- Insufficient Information

No, the answer is incorrect.
Score: 0
Accepted Answers:
17.68 dB

19) Assume that a thermal noise (AWGN) of -54 dBm is added to the signal at the receiver (UE). What will be the SINR of the user, considering only Tier-1 interferers with path loss exponent = 2. *1 point*

- 7.62 dB
- 4.17 dB
- 5.12 dB
- None of these

No, the answer is incorrect.
Score: 0
Accepted Answers:
5.12 dB

20) (19 contd.) How will the SINR change for the above scenario, if the path loss exponent changes to 4? *1 point*

- SNR increases to 17.82 dB
- SNR remains the same
- SNR decreases to 3.72 dB
- None of the above

No, the answer is incorrect.
Score: 0
Accepted Answers:
SNR decreases to 3.72 dB