Question Paper

Exam Date & Time: 20-Jun-2024 (02:30 PM - 05:30 PM)

MANIPAL ACADEMY OF HIGHER EDUCATION

VI SEMESTER B.TECH. (COMPUTER COMMUNICATION ENGINEERING)
MAKE-UP EXAMINATIONS, JULY 2024

WIRELESS COMMUNICATION AND COMPUTING [ICT 3272]

Marks: 50 **Duration: 180 mins.**

Descriptive

Answer all the questions. Section Duration: 180 mins

Answer all Questions

1) Consider a scenario where the handset is assumed to be on a moving vehicle moving away from the base station (assume velocity of movement = v m/s) towards a reflecting surface as shown in Figure Q. 1A. Derive the channel model and obtain the expression for the Doppler shift and the Doppler spread. (5)

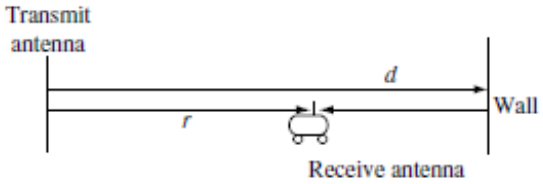

Figure Q. 1A

2) Elaborate the six factors that influence the penetration of cellular network is different in different countries. (3)

3) The loss in a cable is usually defined in decibels per kilometer (dB/km). If the signal at the beginning of a cable is -0.3 dB per km has a power of 2 mW. Find the power of the signal at 5 km. (2)

4) Consider Figure 2A. Assume each base station uses 60 channels, regardless of cell size. If each original cell has a radius of 1 km and each microcell has a radius of 0.5 km. Find the number of channels contained in a 3 km x 3 km square centered around A under the following conditions: (5)

i. Without the use of microcells;

ii. When the lettered microcells as shown in Figure 2A are used;

iii. If all the original base stations are replaced by microcells.

Assume cells on the edge of the square to be contained within the square.

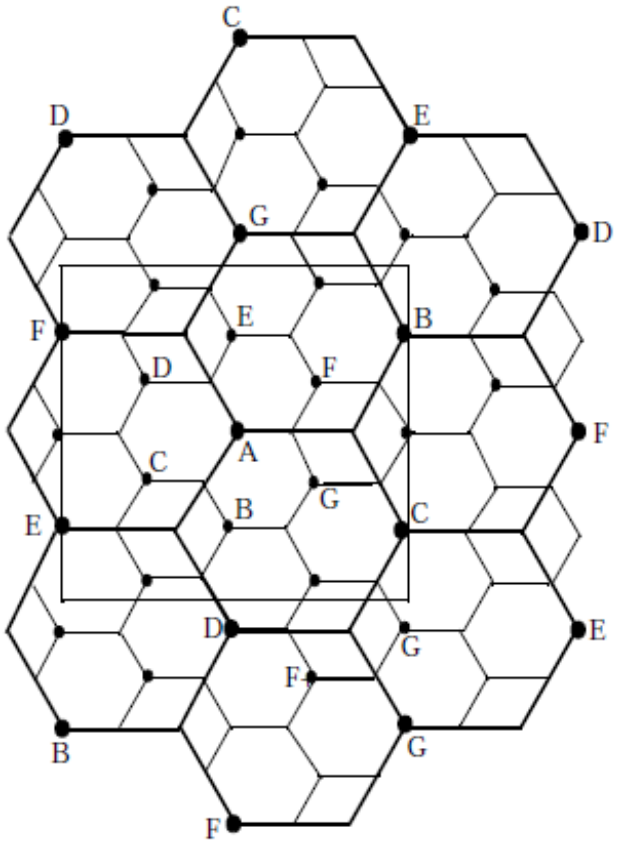

Figure 2A: Cellular Network

5) Assume that the transmitter uses the convolutional coding scheme to encode the original data {101101} with a constraint length of K=3 (starting from an all-zero state). Compute the transmitted data (encoded data) and represent it using a trellis diagram. (3)

6) List the four limitations of unidirectional antennas and analyze their impact on the effectiveness of wireless communication networks. (2)

7) Illustrate the handoff procedure of *Cellular Digital Packet Data* (CDPD). (5)

8) Distinguish between the three technical services of Wireless Application Protocol (WAP) and the i-mode service. (3)

9) Analyze the roles and functionalities of the *Common Packet Channel (CPCH)* and *Downlink Shared CHannel (DSCH)* of WCDMA logical channels. (2)

10) Differentiate between single carrier and multicarrier OFDM signal. Draw the block diagram of OFDM system and elaborate each sub-block associated with OFDM system. (5)

11) Identify the key problem of spectrum sensing in a *hierarchical cognitive radio system* and explain the proposed solutions to overcome the problem. (3)

12) With suitable example explain the CDMA transmitter and receiver. (2)

13) Derive the system model equation for MxN MIMO system and obtain the capacity equation for the same, assuming the channel gain for each path is same. (5)

14) Consider a cooperative communication scenario with three nodes: A, B, and C nodes. Node A transmits the signal to node B. To avoid the deep fade conditions between node A and node B and for obtaining better reliability, node B receives two copies of the same signal: one copy of the signal coming directly from node A and the second copy of the signal coming via node C. However, node C re-transmits the second copy of the signal after processing the signal coming from node A. (3)

Assume the following:

- Distance between A and C: 50 meters
- Distance between B and C: 50 meters
- Distance between A and B: 100 meters
- Transmit power by node A: 20 dBm
- Transmit power by node C: 10 dBm
- Path loss exponent: 3
- Noise power: -100 dBm
- Required signal-to-noise ratio (SNR) for successful communication: 10 dB
- Large scale fading.
- Neglect small scale fading.

Calculate the following:

i. Signal-to-noise ratio (SNR) at node B whenever the signal comes directly and via node C

ii. Sum of the SNR at node B

iii. Capacity per unit bandwidth in case the signal comes from both node A and node C.

15) A SISO system where the signal is transmitted at a power of 0.5 mW. The channel coefficient between the transmitter and receiver nodes is 0.2. Let us assume that the noise variance at the receiving node is 0.6. Calculate the probability of deep fade for this SISO system. (2)

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