COMP4336/9336 Mobile data networking
W1 Quiz on PHY Fundamentals

Q1.

A telephone line is k[illegible] of 15 dB. The input signal power is measured at 1 Watt, and the output [illegible] measured at 1 dBm. What is the signal to noise ratio in dB?

a) 1
b) 14
c) 15
d) -20
e) -10

A1.

1 Watt = 30dBm
Received signal = 30 – 15 = 15dBm
Noise = 1dBm
SNR = signal power(dBm) – noise(dBm) = 15-1 = 14 dB

Q2.

What is the bandwidth of a noiseless channel supporting a data rate of 240 Mbps while using a 64 QAM?

a) 24 MHz
b) 10 MHz
c) 20 MHz
d) 240 MHz
e) 64 MHz

A2.

Nyquist formula is about noise-free channel capacity.

Max. data rate = $240 \times 10^6 = 2 \times B \times \log_2(64) = 12 \times B$
B= 240/12 MHz = 20 MHz

Q3.

What signal to noise ratio (in dB) is required to achieve 20 Mbps through a 10 MHz channel?

a) 3
b) 4.77
c) 5.77
d) 9.89
e) 10

A3.

Shannon's formula is about noisy channel.
20 Mbps = 10 MHz × $\log_2 (1+S/N)$
2 = $\log_2 (1+S/N)$
4 = 1+S/N
S/N = 3
In dB: S/N = $10\log_{10}$

Q4.

A base station allocates one frequency for the downlink communications, while a separate frequency is allocated for the uplink. Which of the following would represent this allocation?

a) FDD
b) TDD
c) Either TDD or FDD
d) Neither TDD nor FDD
e) Half-duplex communication

A4.

As per the definition, FDD means two different frequencies (channels) are allocated for the downlink/uplink, which enables full-duplex communications.

Q5.

If a wireless signal has a wavelength greater than 40cm, it is likely to represent which of the following mobile networking technologies?

a) IoT
b) Bluetooth
c) WiFi
d) Cellular
e) None of these

A5

WiFi 802.11af targets 700MHz, which has a wavelength of 42.8cm (Table 2, page 4, in Chapter 2 of the textbook "Wireless and Mobile Networking")

Q6.

What is the channel coherence time for a 2.4 GHz WiFi link connecting a car, travelling at 100 km/hr, to a stationary base station?

a) 5 ms

b) 2 ms
c) 2.5 ms
d) 2.25 ms
e) 2.15 ms

A6.

v = 100 km/hr = 100
Doppler spread = 2v 0^9)/(36x3x10^8) = 444.44 Hz
Coherence Time = 1 /444.44 = 2.25 ms

Q7.

To transmit 2-bit symbols, a transmitter uses the following 5-bit codewords (5-bit codewords are eventually transmitted instead of 2-bit symbols):

Data Codeword

00 --> 00000

01 --> 00111

10 --> 11001

11 --> 11110

What errors this coding scheme can detect?

a) 1-bit errors only
b) 1-bit and 2-bit errors
c) 2-bit errors only
d) 3-bit errors only
e) 2-bit and 3-bit errors

A7.

HD(1-2): 3
HD(1-3): 3
HD(1-4): 4
HD(2-3): 4
HD(2-4): 3
HD(3-4): 3

Thus, the minimum Hamming distance is 3, which can detect up to 2-bit errors.

Q8.

If a mobile error coding system uses a minimum Hamming distance of 4, which of the following statements is correct?

a) **All single bit errors can be detected**
b) All double bit errors can be corrected
c) All 4-bit errors [illegible]
d) All triple bit e[illegible]d
e) Bit errors can[illegible] CANNOT be corrected

A8.

Any single bit error will still be closer to the original codeword compared to any other codewords, so it can be corrected. Note that, to correct double bit errors, we need a minimum Hamming distance of 2x2+1 = 4

Q9.

If a mobile technology wants to allow multiple co-located devices to use the same frequency at the same time, which of the following multiple access techniques would be most appropriate for them?

a) FDMA
b) TDMA
c) **CDMA**
d) Either TDMA or CDMA
e) Either TDMA or FDMA

A9.

Only CDMA allows co-located devices to use the same frequency at the same time without interfering with each other. This is done by forcing the devices to use a unique *code* for coding all their data transmissions.

Q10.

To achieve high security, a secret service agent is using a direct-sequence spread spectrum with a spreading factor of 10,000 for all its transmissions. To transmit a message comprising of 10,000 bits, the transmitter will have to transmit

a) 100 thousand bits
b) 1 million bits
c) 10 million bits
d) **100 million bits**
e) 1 billion bits

A10.

10,000 x 10,000 = 100,000,000