# ITS323 – Quiz 3 Answers

Name: _____

ID: _____ Mark: _____ (out of 10)

**Question 1** [4 marks]

Assuming free-space propagation, what is the path loss between source and destination if both antenna's have gain 10dBi, the source transmits with power -14dBW/-14dBm and the received power is -90dBm/-110dBW?

**Answer**

Using the equation in the answer above you can find the path loss. Note that both transmit and receive power should be in the same units (dBm OR dBW). To convert from dBW to dBm add 30dB. Why?

$$P_{dBW} = 10\log_{10}\left(\frac{P}{1\text{W}}\right)$$

For the same $P$:

$$\begin{aligned} P_{dBm} &= 10\log_{10}\left(\frac{P}{1\text{mW}}\right) \\ &= 10\log_{10}\left(\frac{1000\times P}{1\text{W}}\right) \\ &= 10\log_{10}(1000) + 10\log_{10}\left(\frac{P}{1\text{W}}\right) \\ &= 30 + P_{dBW} \end{aligned}$$

Using this (and converting power to dBm), Path Loss is: $Loss = P_t + G_t + G_r - P_r$

Loss = (-14+30) + 10 + 10 - (-90) = 126dB

Alternative answer: Loss = -14 + 10 + 10 - (-110 + 30) = 86dB

**Question 1** [3 marks]

In a wireless communications system a source transmits with power 2dBW/5dBm. Both transmit and receive antenna gains are 10dBi/12dBi. If the path loss between antennas is measured to be 60dB/90dB, what is the received power?

**Answer**

In dB: $P_r = P_t + G_t + G_r - Loss$ therefore $P_r$ = -38dBW

For alternative values (5dBm, 12dBi, 90dB): $P_r$ = -61dBm

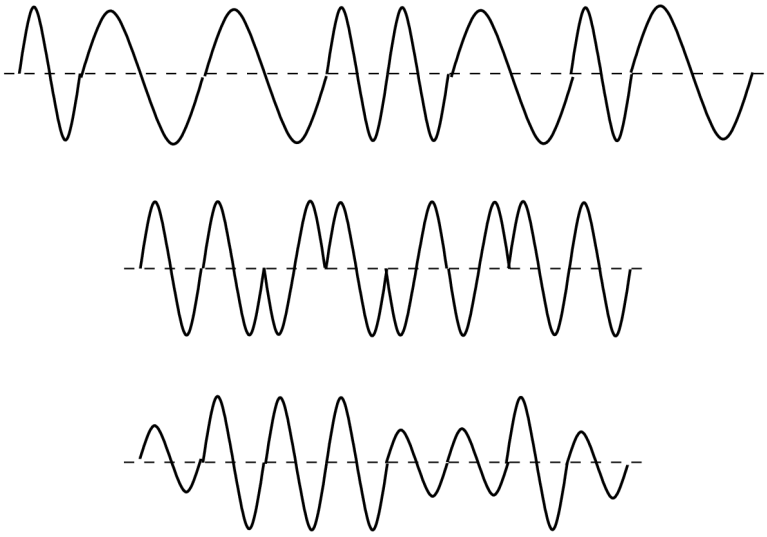
**Question 2** [3 marks]

Consider the following received signal which uses two levels to represent data.

a) The first received bit is given. Completing the remaining bits. [2 marks]

1 ___ ___ ___ ___ ___ ___ ___

b) What is the name of this encoding scheme? [1 mark]



**Answers**

Assuming first bit is 1.

Signal 1: Frequency Shift Keying. Data: 10011010

Signal 2: Phase Shift Keying. Data: 11010011

Signal 3: Amplitude Shift Keying. Data: 10001101

If the first provided bit is 0, then the above answers will be inverted (i.e. 0 replaced with 1).

**Question 2** [1 marks]

What is the name of the encoding scheme that varies the frequency/amplitude/phase of the input carrier signal as the input analog data changes?

**Answer**

Frequency/Amplitude/Phase Modulation

**Question 2** [1 marks]

What is the name of the encoding scheme that varies the frequency/amplitude/phase of the output signal as the input digital data changes?

**Answer**

Frequency/Amplitude/Phase Shift Keying

**Question 3** [3 marks]

a) A transmitter adds a 1-bit even parity bit to the front (left-most position) of the 8-bits of data 01101010. If the last bit | two bits (right | left-most position) is in error, what does the receiver do? (e.g. is an error detected – why? Or not detected – why?) [2 marks]

**Answer**

Even parity: should be even number of 1's in transmitted (Tx) data (and also in Rx data).

Odd parity: should be odd number of 1's in transmitted (Tx) data (and also in Rx data).

| | | | |
|---|---|---|---|
| Data: 01101010 | Tx: **0**01101010 | Rx: 001101011 | Outcome: Detects an error |
| Data: 01101010 | Tx: **0**01101010 | Rx: 00110101**01** | Outcome: Error not detected |
| Data: 01101010 | Tx: **0**01101010 | Rx: **1**01101010 | Outcome: Detects an error |
| Data: 01101010 | Tx: **0**01101010 | Rx: **11**1101010 | Outcome: Error not detected |

b) Using this error-detection scheme and assuming no errors, what is the throughput for a link with data rate 1.8Mb/s | 270kb/s | 360kb/s | 4.5Mb/s? [1 mark]

**Answer**

8-bits of original data, 9-bits transmitted in total, efficiency of 8/9.

| | |
|---|---|
| Data rate: 1.8Mb/s | Throughput: 1.6Mb/s |
| Data rate: 270Kb/s | Throughput: 240kb/s |
| Data rate: 360Kb/s | Throughput: 320kb/s |
| Data rate: 4.5Mb/s | Throughput: 4.0Mb/s |

**Question 4** [3 marks]

If 32/16/24-bit, 20/30/40kHz PCM is used to encoded a single-channel 5 minute song, how long will it take to send this song to your friend's computer if the computers are linked via 100Mb/s Ethernet /10Mb/s Wireless LAN?

**Answer**

With a sampling rate of 20kHz, there are 20,000 samples per second, each sample consisting of 32 bits. That is, 640,000 bits per second. 5 minutes is 300 seconds. Therefore the file is 192Mbits. Sent at 100Mb/s will take 1.92 seconds.

Alternative answer (16-bit, 30Khz, 10Mb/s): 14.4 seconds

Alternative answer (24-bit, 40Khz, 10Mb/s): 28.8 seconds