ITS323 – Quiz 2 Answers

Name: _____

ID: _____ Mark: _____ (out of 10)

Question 1 [3 marks]

a) Draw a plot of the following signal in the frequency domain. [2 marks]

$$s(t)=3\sin(200\pi t)+\sin(600\pi t)+\frac{3}{5}\sin(1000\pi t)$$

$$s(t)=5\sin(4000\pi t)+\frac{5}{3}\sin(12000\pi t)+\sin(20000\pi t)$$

$$s(t)=6\sin(1200\pi t)+2\sin(3600\pi t)+\frac{6}{5}\sin(6000\pi t)$$

Answer

f = 100 Hz, BW = 500 – 100 = 400 Hz, Peak Amp. = 3

f = 2000 Hz, BW = 10000 – 2000 = 8000 Hz, Peak Amp. = 5

f = 600 Hz, BW = 3000 – 600 = 2400 Hz, Peak Amp. = 6

See figures for alternative Question 1.

b) What is the absolute bandwidth of the signal? [1 mark]

Answer

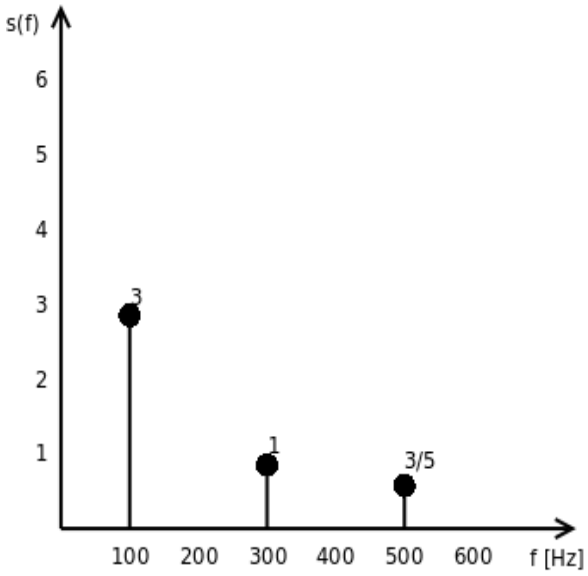
400 Hz

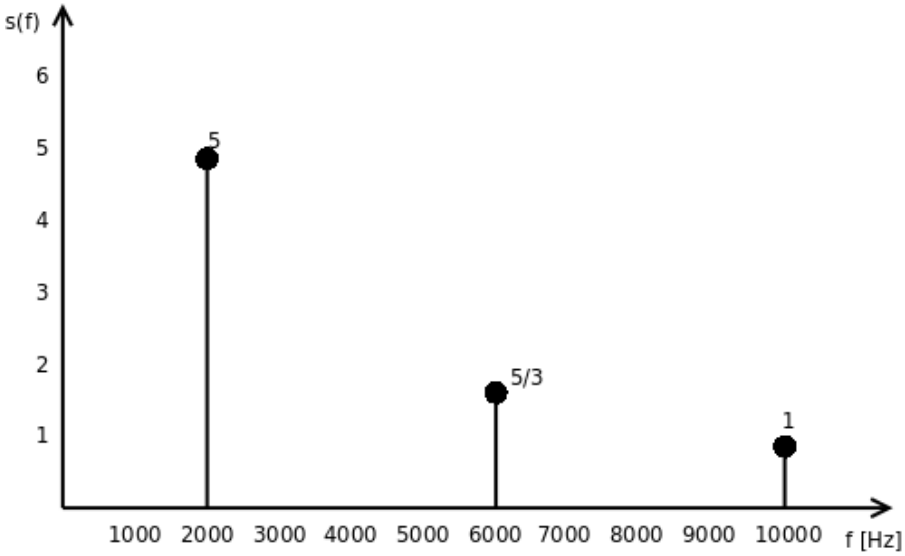
8000 Hz

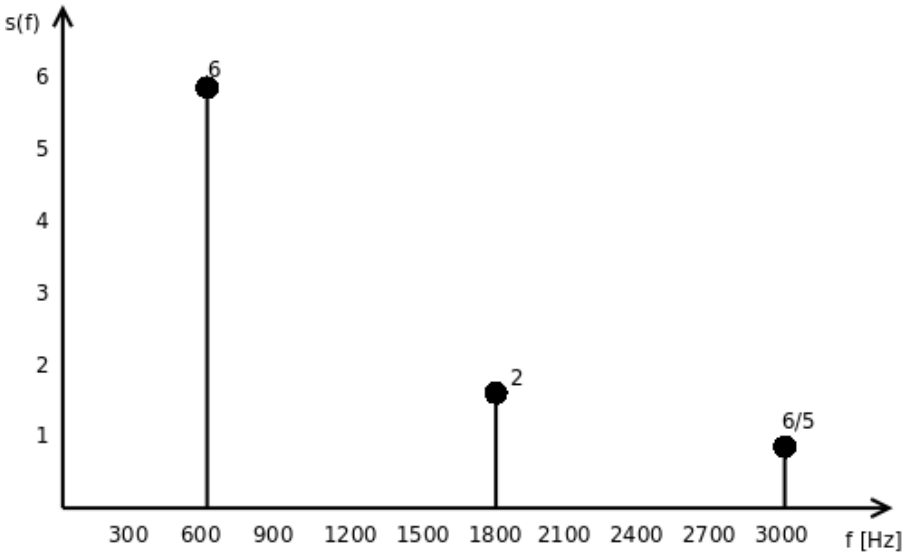
2400 Hz

Question 1 [3 marks]

a) Write an equation for the signal *s(t)* shown in the the plot below. [2 marks]


s(f)
6
5
4
3
2
1
3
1
3/5
100 200 300 400 500 600
f [Hz]


s(f)
6
5
4
3
2
1
5
5/3
1
1000 2000 3000 4000 5000 6000 7000 8000 9000 10000
f [Hz]


s(f)
6
5
4
3
2
1
6
2
6/5
300 600 900 1200 1500 1800 2100 2400 2700 3000
f [Hz]

Answer

See equations for alternative Question 1

b) What is the absolute bandwidth of the signal? [1 mark]

Answer

400 Hz

8000 Hz

2400 Hz

Question 2 [4 marks]

An encoding scheme maps 3/4/3 bits of digital data into one signal element.

a) In a noise-free channel with a bandwidth of 100KHz/50MHz/20KHz, what is the maximum theoretical data rate possible? [2 marks]

Answer

If there are *n* bits of data mapped to a signal element, then 2^n different signal elements are needed to represent any combination of bits. That is, there are $M = 2^n$ possible signal levels.

Using Nyquist capacity equation, Data rate = $2B\log_2(M)$

n = 3, M = 8, BW = 100KHz, Data rate = 600Kb/s

n = 4, M = 16, BW = 50MHz, Data rate = 400Mb/s

n = 3, M = 8, BW = 20KHz, Data rate = 120Kb/s

b) Explain how can the data rate be increased, without increasing the bandwidth. [1 mark]

Answer

Increase the number of levels, e.g. more bits per signal element.

c) What is a disadvantage of increasing the data rate with the approach you suggest in part (b)? [1 mark]

Answer

Increase the number of errors.

Question 2 [4 marks]

A receiver receives a 100KHz/2MHz/500kHz signal with power 310mW/140mW/30μW.

a) If the channel also contains noise of 10mW/20mW/2μW, what is the theoretical data rate possible? [2 marks]

Answer

Using Shannon capacity equation, Data rate = B $\log_2(1+SNR)$

B = 100KHz, Signal = 310mW, Noise = 10mW, SNR = 31, Data rate = 500Kb/s

B = 2MHz, Signal = 140mW, Noise = 20mW, SNR = 7, Data rate = 6Mb/s

B = 500kHz, Signal = 30μW, Noise = 2μW, SNR = 15, Data rate = 2Mb/s

b) Assuming the noise cannot be controlled, explain how can the data rate be increased, without increasing the bandwidth. [1 mark]

Answer

Increase the transmit power, thereby increasing receive power and SNR.

c) What is a disadvantage of increasing the data rate with the approach you suggest in part (b)? [1 mark]

Answer

Uses up battery/electricity at transmitter; interfere with other sources.

Question 3 [1 mark]

Twisted pair copper cables provide lower data rate, but higher transmission distance than optical fibre. TRUE **FALSE**

Shielded Twisted Pair (STP) can provide higher data rates than Unshielded Twister Pair (UTP), but is harder to install. **TRUE** FALSE

Satellite microwave is used in a point-to-point topology, but not in a point-to-multipoint topology. TRUE **FALSE**

Coaxial cable can provide higher data rates, and transmit over a larger distance than twisted pair copper cables. **TRUE** FALSE

Parabolic dish antennas that operate at a high frequency have a lower gain than those of the same size that operate at a low frequency TRUE **FALSE**

The wireless link from SIIT Bangkadi to SIIT Rangsit is an example of (multiple choice):

(a) **Terrestrial Microwave** (b) Satellite Microwave (c) Broadcast Radio

Question 4 [2 marks]

The path between SIIT Bangkadi and SIIT Rangsit is measured to have a power loss of 90/90/100dB. Both transmit and receive antenna's are identical, with a gain of 10dBi. Using a transmit power of 1/10/0.1W, what is the maximum receive power threshold for successful reception?

Answer

$$P_{r_{dBW}} = P_{t_{dBW}} + G_{t_{dBi}} + G_{r_{dBi}} - Loss_{dB}$$

L = 90dB, Pt = 1W, Pt = 0dBW, Pr = -70dBW

L = 90dB, Pt = 10W, Pt = 10dBW, Pr = -60dBW

L = 100dB, Pt = 0.1W, Pt = -10dBW, Pr = -90dBW

Question 4 [2 marks]

The path between SIIT Bangkadi and SIIT Rangsit is measured to have a power loss of 90/110/95dB. Both transmit and receive antenna's are identical, with a gain of 10dBi. If the receiver has a receive power threshold of -80/-70/-60dBW, what is the minimum transmit power for successful reception?

Answer

$$P_{t_{dBW}} = P_{r_{dBW}} - G_{t_{dBi}} - G_{r_{dBi}} + Loss_{dB}$$

L = 90dB, Pr = -80dBW, Pt = -10dBW

L = 110dB, Pr = -70dBW, Pt = 20dBW

L = 95dB, Pr = -60dBW, Pt = 15dBW