

## ITS 323 – QUIZ 2 (ITB) ANSWERS

First name: \_\_\_\_\_ Last name: \_\_\_\_\_

ID: \_\_\_\_\_

Total Marks: \_\_\_\_\_

out of 8.5

### Question 1 [3 marks]

- a) What is the bandwidth of a signal that can be decomposed into four sine waves with frequencies at 30, 80, 180, and 280 MHz?

**Answer: 250 MHz**

- b) A device is sending out data at the rate of 1000bps. How long does it take to send out 10 bits?

**Answer: 0.01sec**

- c) *Circle the correct words:* Making a telephone call over the ordinary fixed-line telephone network is an example sending [ Analog / Digital ] data over a [ Analog / Digital ] signal.

**Answer: Analog, Analog**

- d) Consider the following two signals:

$$S1 = (4/\pi) [\sin(2\pi ft) + (1/3)\sin(2\pi(3f)t) + (1/5)\sin(2\pi(5f)t)]$$

$$S2 = (4/\pi) [\sin(2\pi ft)]$$

If our transmission system supports the bandwidth of 8kHz, which signal (S1 or S2) provides the highest data rate?

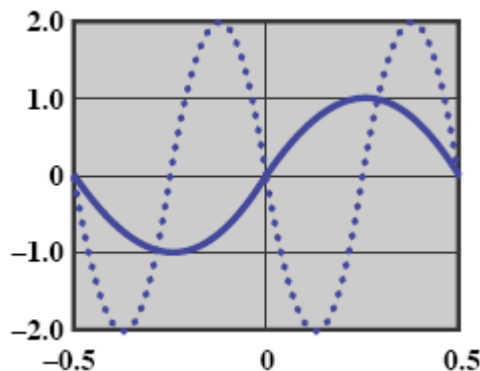
**Answer: S2**

- e) From your answer of part (d), although the signal you selected provides the highest data rate, what is a disadvantage of the signal (compared to the other lower data rate signal)?

**Answer: More errors**

### Question 2 [1.5 mark]

If the solid curve of the figure below represents  $\sin(2\pi t)$ , what does the dotted curve represent? That is, the dotted curve can be written in the form  $A \sin(2\pi ft + \phi)$ ; what are  $A$ ,  $f$ , and  $\phi$ ?



Answer:

A: 2

f: 2

$\phi$ :  $\pi$

**Question 3** [2 marks]

Given a channel with an intended capacity of 18kb/s, the bandwidth of the channel is 3kHz. What signal-to-noise ratio is required to achieve this capacity?

**Answer:**

$$C = B \log_2 (1 + \text{SNR})$$

$$18\text{kb/s} = 3\text{kHz} \log_2 (1 + \text{SNR})$$

$$6 = \log_2 (1 + \text{SNR})$$

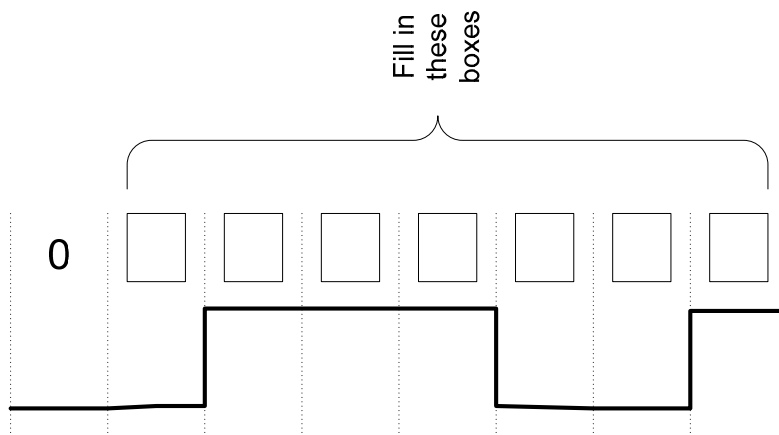
$$1 + \text{SNR} = 2^6$$

$$\text{SNR} = 63$$

$$\text{(and in dB, } \text{SNR}_{\text{dB}} = 10 \log_{10} (63) = 18\text{dB)}$$

**Question 4** [2 marks]

If the **Non-Return-to-Zero Invert on ones (NRZI)** encoding scheme is used, complete the bit pattern that the following signal represents. (That is, fill in the boxes).



Answer: 0100101