

# BIT REPRESENTATIONS AND LTI SYSTEMS

## SECTION 1 QUESTION 1 (2/2 points)

Assume that we transmit a text message by encoding each character using its ASCII code, and create a bit sequence by concatenating the ASCII codes, where each codeword is listed with the LSB first.

Suppose we obtain the following bit sequence:

**01000010100101100010111011001110**

Use the ASCII table below to determine the original text string. Note that in the table, the ASCII codes are listed with the MSB first.

Please input the original text message in the box below

Bits

0	0011 0000	O	0100 1111	m	0110 1101
1	0011 0001	P	0101 0000	n	0110 1110
2	0011 0010	Q	0101 0001	o	0110 1111
3	0011 0011	R	0101 0010	p	0111 0000
4	0011 0100	S	0101 0011	q	0111 0001
5	0011 0101	T	0101 0100	r	0111 0010
6	0011 0110	U	0101 0101	s	0111 0011
7	0011 0111	V	0101 0110	t	0111 0100
8	0011 1000	W	0101 0111	u	0111 0101
9	0011 1001	X	0101 1000	v	0111 0110
A	0100 0001	Y	0101 1001	w	0111 0111
B	0100 0010	Z	0101 1010	x	0111 1000
C	0100 0011	a	0110 0001	y	0111 1001
D	0100 0100	b	0110 0010	z	0111 1010
E	0100 0101	c	0110 0011	.	0010 1110
F	0100 0110	d	0110 0100	,	0010 0111
G	0100 0111	e	0110 0101	:	0011 1010
H	0100 1000	f	0110 0110	;	0011 1011
I	0100 1001	g	0110 0111	?	0011 1111
J	0100 1010	h	0110 1000	!	0010 0001
K	0100 1011	i	0110 1001	'	0010 1100
L	0100 1100	j	0110 1010	"	0010 0010
M	0100 1101	k	0110 1011	{	0010 1000
N	0100 1110	l	0110 1100	}	0010 1001
			space		0010 0000

Suppose that a receiver samples the incoming signal using a sampling frequency of  $F_s = 50$  kilosamples/second. If a signal of 4800 samples corresponds to 120 bits, what was the bit rate in bits per second?

Please key in the numerical value of your answer in the box provided below.

Help

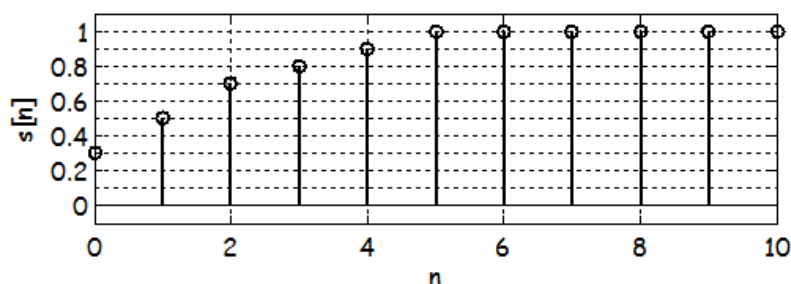
125

125

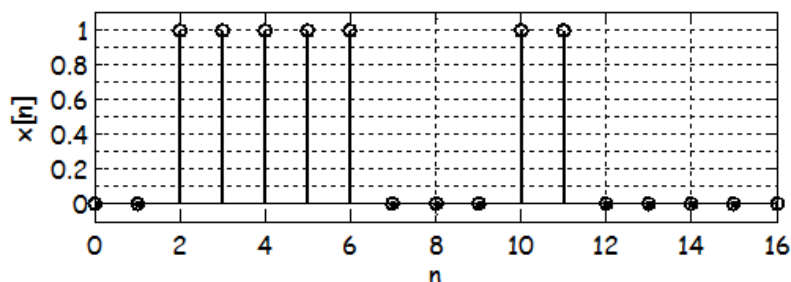
You have used 1 of 1 submissions

### SECTION 1 QUESTION 3 INTRODUCTION

Consider a linear and time-invariant channel whose step response  $s[n]$  is shown in the following diagram for  $n = 0$  to  $n = 10$ .



Suppose that the waveform  $x[n]$  plotted below is applied as the input to this channel. Assume that  $x[n] = 0$  for all  $n < 0$ .



### SECTION 1 QUESTION 3 PART A (2/2 points)

Express the input  $x[n]$  in terms of the step function  $u[n]$ .

Please select the correct answer.

☐  $x[n] = u[n - 2] - u[n - 6] + u[n - 10] - u[n - 11]$

☐  $x[n] = u[n - 2] + u[n - 6] + u[n - 10] + u[n - 11]$

☒  $x[n] = u[n - 2] - u[n - 7] + u[n - 10] - u[n - 12]$  ✓

☐  $x[n] = u[n - 2] + u[n - 7] + u[n - 10] + u[n - 12]$

Help

You have used 1 of 1 submissions

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**SECTION 1 QUESTION 3 PART B** (2/2 points)

Let the output of the channel be denoted by  $y[n]$ . Determine the value of  $y[12]$ :

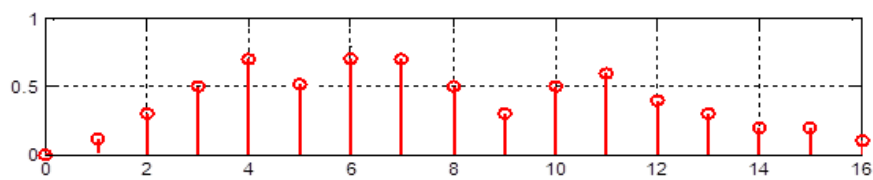
Please key in the numerical value of your answer in the box provided below.

You have used 1 of 1 submissions

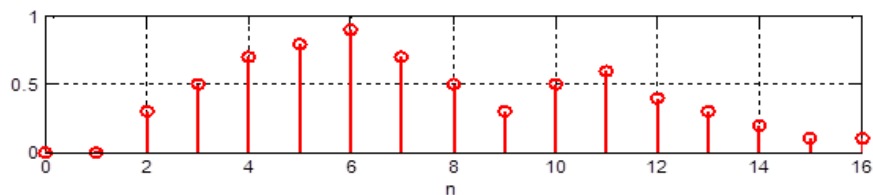
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**SECTION 1 QUESTION 3 PART C** (2 points possible)

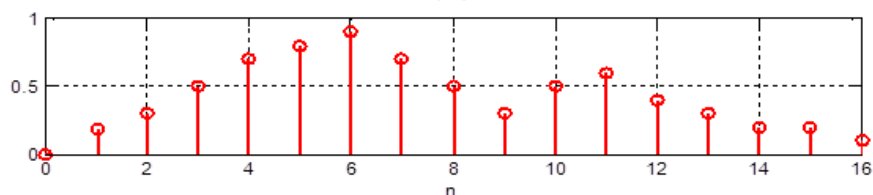
Which one of the following waveforms corresponds to the output  $y[n]$ ?



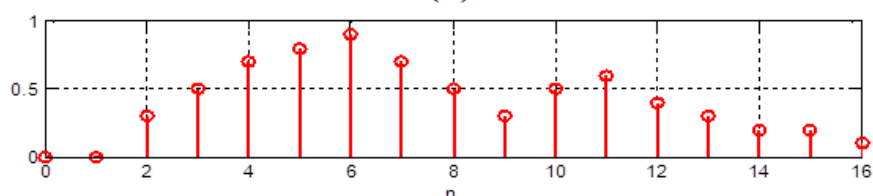
(A)



(B)



(C)



(D)

Please select the correct answer.

☐ A

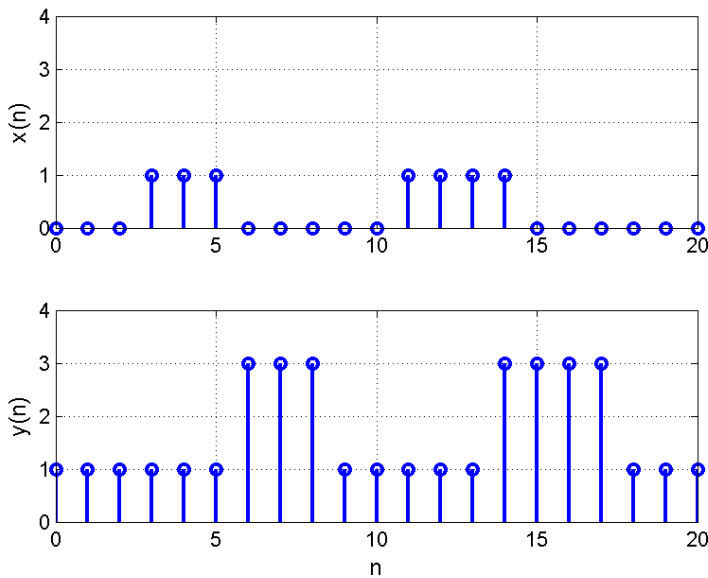
☐ B

☒ C **X**
☐ D

You have used 1 of 1 submissions

## SECTION 1 QUESTION 4 (2 points possible)

The figure below shows the input  $x(n)$  and output  $y(n)$  of a communication channel.



Which one of the following models best describes this channel?

- ☐  $y[n] = 2 \cdot x[n + 3] + 1$
- ☐  $y[n] = 2 \cdot x[n - 3] + 1$
- ☐  $y[n] = 3 \cdot x[n + 3] + 1$
- ☒  $y[n] = 3 \cdot x[n - 3] + 1$  ✖

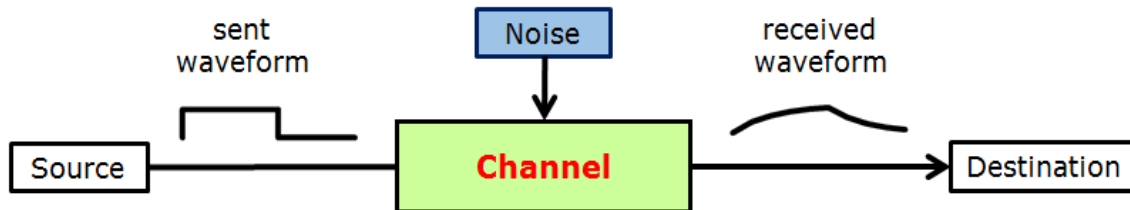
You have used 1 of 1 submissions

## SECTION 1 MATLAB QUESTION (3 points possible)

Consider the transmission of a random bit sequence over an LTI channel with known step response. Your job in this MATLAB question is to predict the output of the channel given the input bit sequence and the number of samples used to transmit each bit.

In the initial code, the function **bit\_seq\_gen\_final** in the code window generates a random bit sequence stored in **bs** and selects a random samples per bit, **SPB**, to use for transmission. It also creates a prediction of the channel output, assuming that the input bit sequence is 10000..., each bit is transmitted using SPB samples, and that the step response of the channel at sample index  $n$  is **step\_response\_final(n)**, and stores it in the vector **y**. Since the bit stream is random, this prediction is (usually) incorrect. The function **compare(y,bs,SPB)** generates a plot comparing the prediction in **y** to the actual channel output.

Your job is to modify the code so that **y** contains the correct prediction the output of the channel given **bs** and **SPB**. Do not change the values of **bs** and **SPB** in your code.



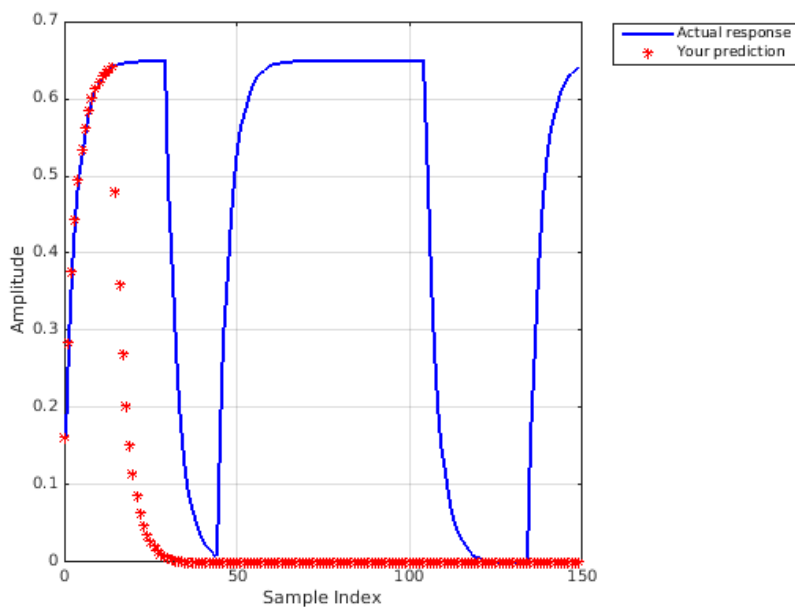
```

1 % Generate a random 10 bit sequence and a random SPB
2 % Do not change the values of bs and SPB in your code
3 [bs,SPB] = bit_seq_gen_final;
4
5 n = 0:(length(bs)*SPB-1); % sample index
6 y = zeros(1,length(bs)*SPB); % Vector to store the channel response
7
8 % Modify the code below to predict the channel response
9 y = y + step_response_final(n)-step_response_final(n-SPB);
10
11 % Do not modify the code below
12 compare(y,bs,SPB); % Compare the predicted and actual responses
13

```

Unanswered

Figure 1

**Run Code**

Check

Reset

Save

You have used 0 of 5 submissions



Help



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