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Profesor:

Alfonso Fernández Vázquez

Alumno:

Castro Cruces Jorge Eduardo

Boleta:

2015080213

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**Contenido**

[A. Project 1.1 Unit Sample and Unit Step Sequences 5](#_Toc82952996)

[ Questions: 5](#_Toc82952997)

[1) Q1.1 Run Program P1 1 to generate the unit sample sequence u[n] and display it. 5](#_Toc82952998)

[2) Q1.2 What are the purposes of the commands clf, axis, title, xlabel, and ylabel? 5](#_Toc82952999)

[3) Q1.3 Modify Program P1 1 to generate a delayed unit sample sequence ud[n] with a delay of 11 samples. Run the modified program and display the sequence generated. 6](#_Toc82953000)

[4) Q1.4 Modify Program P1 1 to generate a unit step sequence s[n]. Run the modified program and display the sequence generated. 6](#_Toc82953001)

[5) Q1.5 Modify Program P1 1 to generate a delayed unit step sequence sd[n] with an advance of 7 samples. Run the modified program and display the sequence generated. 7](#_Toc82953002)

[B. Project 1.2 Exponential Signals 9](#_Toc82953003)

[ Questions: 9](#_Toc82953004)

[6) Q1.6 Run Program P1 2 and generate the complex-valued exponential sequence. 9](#_Toc82953005)

[7) Q1.7 Which parameter controls the rate of growth or decay of this sequence? Which parameter controls the amplitude of this sequence? 10](#_Toc82953006)

[8) Q1.8 What will happen if the parameter c is changed to (1/12)+(pi/6)\*i? 10](#_Toc82953007)

[9) Q1.9 What are the purposes of the operators real and imag? 11](#_Toc82953008)

[10) Q1.10 What is the purpose of the command subplot? 11](#_Toc82953009)

[11) Q1.11 Run Program P1 3 and generate the real-valued exponential sequence. 11](#_Toc82953010)

[12) Q1.12 Which parameter controls the rate of growth or decay of this sequence? Which parameter controls the amplitude of this sequence? 12](#_Toc82953011)

[13) Q1.13 What is the difference between the arithmetic operators ^ and .^? 12](#_Toc82953012)

[14) Q1.14 What will happen if the parameter a is less than 1? Run Program P1 3 again with the parameter a changed to 0.9 and the parameter K changed to 20. 12](#_Toc82953013)

[15) Q1.15 What is the length of this sequence and how can it be changed? 13](#_Toc82953014)

[16) Q1.16 You can use the MATLAB command sum(s.\*s) to compute the energy of a real sequence s[n] stored as a vector s. Evaluate the energy of the real-valued exponential sequences x[n] generated in Questions Q1.11 and Q1.14. 13](#_Toc82953015)

[C. Project 1.3 Sinusoidal Sequences 15](#_Toc82953016)

[ Questions: 15](#_Toc82953017)

[17) Q1.17 Run Program P1 4 to generate the sinusoidal sequence and display it. 15](#_Toc82953018)

[18) Q1.18 What is the frequency of this sequence and how can it be changed? Which parameter controls the phase of this sequence? Which parameter controls the amplitude of this sequence? What is the period of this sequence? 16](#_Toc82953019)

[19) Q1.19 What is the length of this sequence and how can it be changed? 16](#_Toc82953020)

[20) Q1.20 Compute the average power of the generated sinusoidal sequence. 16](#_Toc82953021)

[21) Q1.21 What are the purposes of the axis and grid commands? 16](#_Toc82953022)

[22) Q1.22 Modify Program P1 4 to generate a sinusoidal sequence of frequency 0.9 and display it. Compare this new sequence with the one generated in Question Q1.17. Now, modify Program P1 4 to generate a sinusoidal sequence of frequency 1.1 and display it. Compare this new sequence with the one generated in Question Q1.17. Comment on your results. 17](#_Toc82953023)

[23) Q1.23 Modify the above program to generate a sinusoidal sequence of length 50, frequency 0.08, amplitude 2.5, and phase shift 90 degrees and display it. What is the period of this sequence? 17](#_Toc82953024)

[24) Q1.24 Replace the stem command in Program P1 4 with the plot command and run the program again. What is the difference between the new plot and the one generated in Question Q1.17? 18](#_Toc82953025)

[25) Q1.25 Replace the stem command in Program P1 4 with the stairs command and run the program again. What is the difference between the new plot and those generated in Questions Q1.17 and Q1.24? 19](#_Toc82953026)

[D. Project 1.4 Random Signals 20](#_Toc82953027)

[ Questions: 20](#_Toc82953028)

[26) Q1.26 Write a MATLAB program to generate and display a random signal of length 100 whose elements are uniformly distributed in the interval [−2, 2]. 20](#_Toc82953029)

[27) Q1.27 Write a MATLAB program to generate and display a Gaussian random signal of length 75 whose elements are normally distributed with zero mean and a variance of 3. 21](#_Toc82953030)

[28) Q1.28 Write a MATLAB program to generate and display five sample sequences of a random sinusoidal signal of length 31 22](#_Toc82953031)

[where the amplitude A and the phase φ are statistically independent random variables with uniform probability distribution in the range 0 ≤ A ≤ 4 for the amplitude and in the range for the phase. 22](#_Toc82953032)

[E. Project 1.5 Signal Smoothing 24](#_Toc82953033)

[ Questions: 24](#_Toc82953034)

[29) Q1.29 Run Program P1 5 and generate all pertinent signals. 24](#_Toc82953035)

[30) Q1.30 What is the form of the uncorrupted signal s[n]? What is the form of the additive noise d[n]? 25](#_Toc82953036)

[31) Q1.31 Can you use the statement x=s+d to generate the noise-corrupted signal? If not, why not? 25](#_Toc82953037)

[32) Q1.32 What are the relations between the signals x1, x2, and x3, and the signal x? 25](#_Toc82953038)

[33) Q1.33 What is the purpose of the legend command? 25](#_Toc82953039)

[F. Project 1.6 Generation of Complex Signals 26](#_Toc82953040)

[ Questions: 26](#_Toc82953041)

[34) Q1.34 Run Program P1 6 and generate the amplitude modulated signal y[n] for various values of the frequencies of the carrier signal xH[n] and the modulating signal xL[n], and various values of the modulation index m. 26](#_Toc82953042)

[35) Q1.35 What is the difference between the arithmetic operators \* and .\* ? 28](#_Toc82953043)

[ Questions: 29](#_Toc82953044)

[36) Q1.36 Run Program P1 7 and generate the swept-frequency sinusoidal sequence x[n]. 29](#_Toc82953045)

[37) Q1.37 What are the minimum and maximum frequencies of this signal? 30](#_Toc82953046)

[38) Q1.38 How can you modify the above program to generate a swept sinusoidal signal with a minimum frequency of 0.1 and a maximum frequency of 0.3? 30](#_Toc82953047)

# Project 1.1 Unit Sample and Unit Step Sequences

Program P1 1 can be used to generate and plot a unit sample sequence:

1. % Program P1\_1
2. % Generation of a Unit Sample Sequence
3. clf;
4. % Generate a vector from -10 to 20
5. **n = -10:20;**
6. % Generate the unit sample sequence
7. u = [zeros(1,10) 1 zeros(1,20)];
8. % Plot the unit sample sequence
9. stem(n,u);
10. **xlabel(’Time index n’);ylabel(’Amplitude’);**
11. title(’Unit Sample Sequence’);
12. axis([-10 20 0 1.2]);

## Questions:

### Q1.1 Run Program P1 1 to generate the unit sample sequence u[n] and display it.Interfaz de usuario gráfica, Texto, Aplicación Descripción generada automáticamente

### Q1.2 What are the purposes of the commands clf, axis, title, xlabel, and ylabel?

Clf sirve para borrar la figura actual.

Axis controla la escala y apariencia de los ejes.

Title sirve para añadir un título al gráfico generado.

Xlabel añade un título al eje X.

Ylabel añade un título al eje Y

### Q1.3 Modify Program P1 1 to generate a delayed unit sample sequence ud[n] with a delay of 11 samples. Run the modified program and display the sequence generated.

1. % Program P1\_1
2. % Generation of a Unit Sample Sequence
3. clf;
4. % Generate a vector from -10 to 20
5. **n = -10:20;**
6. % Generate the unit sample sequence
7. u = [zeros(1,11) 1 zeros(1,19)];
8. % Plot the unit sample sequence
9. stem(n,u);
10. **xlabel('Time index n');ylabel('Amplitude');**
11. title('Unit Sample Sequence');
12. axis([-10 20 0 1.2]);

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### Q1.4 Modify Program P1 1 to generate a unit step sequence s[n]. Run the modified program and display the sequence generated.

1. % Program P1\_1
2. % Generation of a Unit Sample Sequence
3. clf;
4. % Generate a vector from -10 to 20
5. **n = -10:20;**
6. % Generate the unit sample sequence
7. u = [ones(1, 31)];
8. % Plot the unit sample sequence
9. stem(n,u);
10. **xlabel('Time index n');ylabel('Amplitude');**
11. title('Unit Sample Sequence');
12. axis([-10 20 0 1.2]);

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### Q1.5 Modify Program P1 1 to generate a delayed unit step sequence sd[n] with an advance of 7 samples. Run the modified program and display the sequence generated.

1. % Program P1\_1
2. % Generation of a Unit Sample Sequence
3. clf;
4. % Generate a vector from -10 to 20
5. **n = -10:20;**
6. % Generate the unit sample sequence
7. u = [ones(1, 7) 0 ones(1, 23)];
8. % Plot the unit sample sequence
9. stem(n,u);
10. **xlabel('Time index n');ylabel('Amplitude');**
11. title('Unit Sample Sequence');
12. axis([-10 20 0 1.2]);

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# Project 1.2 Exponential Signals

Program P1 2 given below can be employed to generate a complex-valued exponential sequence.

1. % Program P1\_2
2. % Generation of a complex exponential sequence
3. clf;
4. c = -(1/12)+(pi/6)\*i;
5. **K = 2;**
6. n = 0:40;
7. x = K\*exp(c\*n);
8. subplot(2,1,1);
9. stem(n,real(x));
10. **xlabel(’Time index n’);ylabel(’Amplitude’);**
11. title(’Real part’);
12. subplot(2,1,2);
13. stem(n,imag(x));
14. xlabel(’Time index n’);ylabel(’Amplitude’);
15. **title(’Imaginary part’);**

Program P1 3 given below can be employed to generate a real-valued exponential sequence.

1. % Program P1\_3
2. % Generation of a real exponential sequence
3. clf;
4. n = 0:35; a = 1.2; K = 0.2;
5. **x = K\*a.^+n;**
6. stem(n,x);
7. xlabel(’Time index n’);ylabel(’Amplitude’);

## Questions:

### Q1.6 Run Program P1 2 and generate the complex-valued exponential sequence.

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### Q1.7 Which parameter controls the rate of growth or decay of this sequence? Which parameter controls the amplitude of this sequence?

El rango N controla la frecuencia con la que aparecen valores en la gráfica. Mientras más se extiende el rango, más valores aparecen. K controla la amplitud con la que los valores crecen o decrecen en la gráfica.

### Q1.8 What will happen if the parameter c is changed to (1/12)+(pi/6)\*i?

La gráfica se invierte tomando como referencia el eje Y, es decir, los valores inician con poca amplitud, y conforme se recorre la gráfica hacia la derecha, hacia mayores valores de X, la amplitud aumenta.

Interfaz de usuario gráfica, Aplicación

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### Q1.9 What are the purposes of the operators real and imag?

Los operadores diferencian cuando hay una parte real o imaginaria de una expresión. Esto se aprecia en la gráfica que genera el programa. Entre la parte real y la imaginaria, hay un ligero desfase, además de que la amplitud entre los valores de cada gráfica también varía.

### Q1.10 What is the purpose of the command subplot?

El comando divide la ventana Figure en diferentes secciones, permitiendo mostrar dos gráficas en la misma ventana. Podemos ver que los valores cambian de subplot(2,1,1) a subplot(2,1,2), esto nos indica que el primer conjunto de valores corresponde a la gráfica que se mostrará en la parte superior, y el segundo conjunto a la gráfica que se mostrará en la parte inferior de la ventana Figure.

### Q1.11 Run Program P1 3 and generate the real-valued exponential sequence.

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### Q1.12 Which parameter controls the rate of growth or decay of this sequence? Which parameter controls the amplitude of this sequence?

La variable K define la tasa con la que crece la gráfica en general.

La variable A define la amplitud de cada valor de la secuencia.

### Q1.13 What is the difference between the arithmetic operators ^ and .^?

El operador ^ es una potencia de matrices, mientras que el operador .^ es una potencia de arreglos. Para dar un ejemplo del caso, si quisiéramos resolver la operación Z = X .^ Y, obtendríamos un error si X y Y fueran matrices, por lo tanto, para obtener un resultado válido, deberíamos realizar la operación Z= X ^ Y, donde Y debería ser un escalar y X una matriz cuadrada.

### Q1.14 What will happen if the parameter a is less than 1? Run Program P1 3 again with the parameter a changed to 0.9 and the parameter K changed to 20.

Cuando los valores cambian tal y como dice el inciso, la orientación de la gráfica cambia. Inicia con valores grandes y decrece exponencialmente.

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### Q1.15 What is the length of this sequence and how can it be changed?

La gráfica se muestra para 35 valores de X con los valores que da el programa al inicio. Para aumentar o disminuir el rango en X, hay que ampliar o disminuir el valor de la variable n.

### Q1.16 You can use the MATLAB command sum(s.\*s) to compute the energy of a real sequence s[n] stored as a vector s. Evaluate the energy of the real-valued exponential sequences x[n] generated in Questions Q1.11 and Q1.14.

Si comparamos los valores de ambos casos, vemos que el valor de la energía del segundo caso es menor que el del primero

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# Project 1.3 Sinusoidal Sequences

Program P1 4 is a simple example that generates a sinusoidal signal.

1. % Program P1\_4
2. % Generation of a sinusoidal sequence
3. n = 0:40;
4. f = 0.1;
5. **phase = 0;**
6. A = 1.5;
7. arg = 2\*pi\*f\*n - phase;
8. x = A\*cos(arg);
9. clf; % Clear old graph
10. **stem(n,x); % Plot the generated sequence**
11. axis([0 40 -2 2]);
12. grid;
13. title(’Sinusoidal Sequence’);
14. xlabel(’Time index n’);
15. **ylabel(’Amplitude’);**
16. axis;

## Questions:

### Q1.17 Run Program P1 4 to generate the sinusoidal sequence and display it.

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### Q1.18 What is the frequency of this sequence and how can it be changed? Which parameter controls the phase of this sequence? Which parameter controls the amplitude of this sequence? What is the period of this sequence?

La frecuencia es de 0.1 y le corresponde la variable f.

La fase corresponde a la variable “phase”.

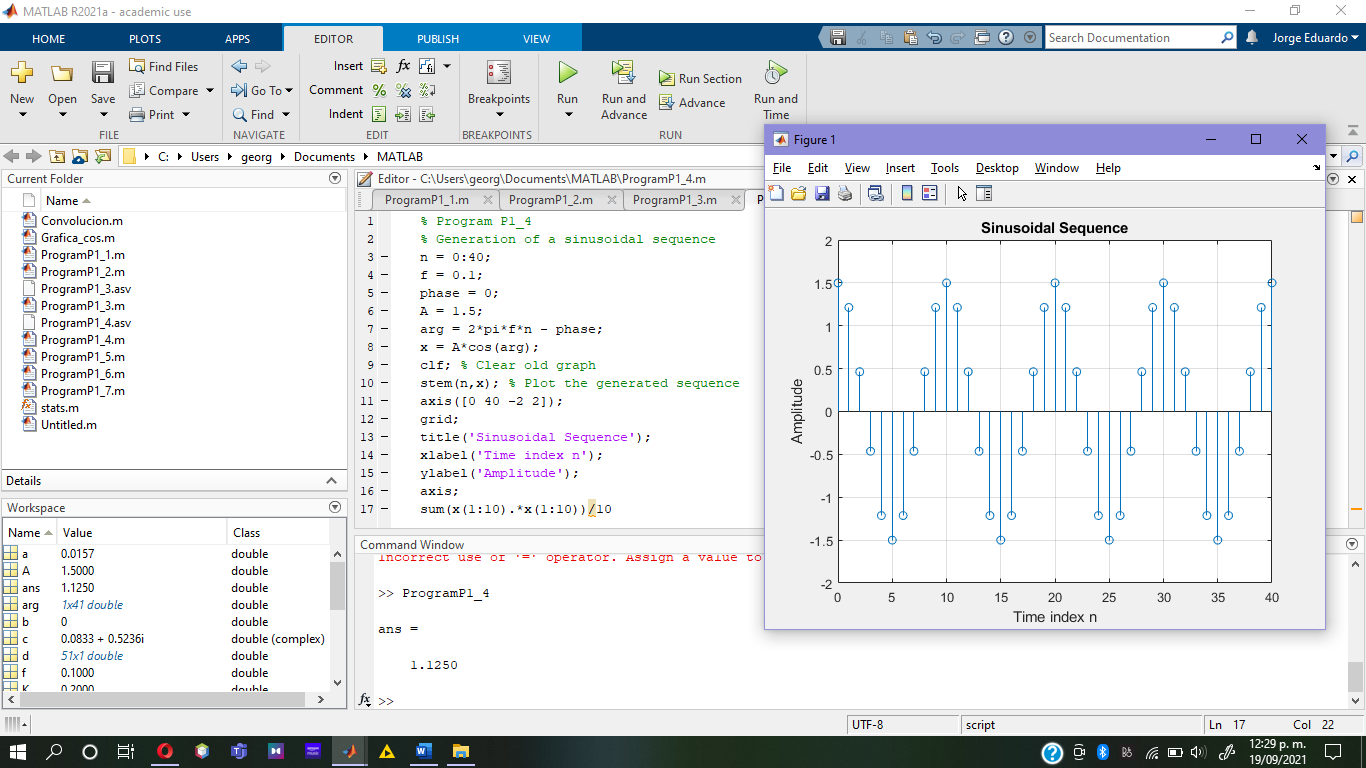
El parámetro de la amplitud es la variable A.

El periodo es de 10, y se calcula con la fórmula

### Q1.19 What is the length of this sequence and how can it be changed?

La longitud de la secuencia depende del intervalo n. Se puede cambiar al aumentar o disminuir el tamaño del intervalo.

### Q1.20 Compute the average power of the generated sinusoidal sequence.



### Q1.21 What are the purposes of the axis and grid commands?

El comando axis especifica los límites de los ejes. El comando grid muestra una cuadrícula dentro de la figura

### Q1.22 Modify Program P1 4 to generate a sinusoidal sequence of frequency 0.9 and display it. Compare this new sequence with the one generated in Question Q1.17. Now, modify Program P1 4 to generate a sinusoidal sequence of frequency 1.1 and display it. Compare this new sequence with the one generated in Question Q1.17. Comment on your results.

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### Q1.23 Modify the above program to generate a sinusoidal sequence of length 50, frequency 0.08, amplitude 2.5, and phase shift 90 degrees and display it. What is the period of this sequence?

El periodo de la secuencia se calcula con la fórmula:

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### Q1.24 Replace the stem command in Program P1 4 with the plot command and run the program again. What is the difference between the new plot and the one generated in Question Q1.17?

Lo que se modifica en la figura es la definición de la gráfica, lo que la vuelve más continua y curva a simple vista.

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### Q1.25 Replace the stem command in Program P1 4 with the stairs command and run the program again. What is the difference between the new plot and those generated in Questions Q1.17 and Q1.24?

La gráfica se vuelve cuadrada como lo indica el comando, “stairs” en español significa escalera.

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Descripción generada automáticamente

# Project 1.4 Random Signals

## Questions:

### Q1.26 Write a MATLAB program to generate and display a random signal of length 100 whose elements are uniformly distributed in the interval [−2, 2].

1. % Problem 1-26
2. % Program to generate and display a random signal of length 100 whose
3. % elements are uniformly distributed in the interval [−2, 2]
4. n = 0:99;
5. **a = 2;**
6. rng ('default');
7. rng ('shuffle');
8. x = 2\*a\*(rand(1, length(n))-0.5);
9. clf;
10. **stem(n, x);**
11. axis([0 length(n) -round(2 \* (a + 0.5)) / 2 round(2 \* (a + 0.5)) / 2]);
12. grid;
13. title ('Problem 1.26');
14. xlabel('Time');
15. **ylabel('Amplitude');**
16. axis;

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### Q1.27 Write a MATLAB program to generate and display a Gaussian random signal of length 75 whose elements are normally distributed with zero mean and a variance of 3.

1. % Problem 1-27
2. % Program to generate and display a Gaussian random signal of length 75
3. % whose elements are normally distributed with zero mean and a variance
4. % of 3
5. **n = 0:74;**
6. zeroMean = 0;
7. standardDeviation = sqrt (3);
8. rng ('default');
9. rng('shuffle');
10. **x = standardDeviation\*randn(1,length(n)) + zeroMean;**
11. clf;
12. stem(n,x);
13. xmax = max(abs(x));
14. Ylim = round(2\*(xmax+0.5))/2;
15. **axis([0 length(n) -Ylim Ylim]);**
16. grid;
17. title('Gaussian signal');
18. xlabel('Time');
19. ylabel('Amplitude');
20. **axis;**

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Descripción generada automáticamente

### Q1.28 Write a MATLAB program to generate and display five sample sequences of a random sinusoidal signal of length 31

### where the amplitude A and the phase φ are statistically independent random variables with uniform probability distribution in the range 0 ≤ A ≤ 4 for the amplitude and in the range for the phase.

1. % Problem 1-28
2. % Program to generate and display five sample sequences of a random
3. % sinusoidal signal of length 31 {X[n]} = {A · cos(ωon + φ)}
4. n = 0:30;
5. **f = 0.1;**
6. A = 4;
7. phi = 2\*pi;
8. rng ('default');
9. rng('shuffle');
10. **W = A\*rand;**
11. z = phi\*rand;
12. arg = 2\*pi\*f\*n + z;
13. x = W\*cos(arg);
14. clf;
15. **stem(n,x);**
16. Ylim = round (2\*(A+0.5))/2;
17. axis( [0 length(n) -Ylim Ylim]);
18. grid;
19. title('Sinusoidal sequence');
20. **xlabel('Time');**
21. ylabel('Amplitude');
22. axis;

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Descripción generada automáticamente

# Project 1.5 Signal Smoothing

Program P1 5 implements the above algorithm.

1. % Program P1\_5
2. % Signal Smoothing by Averaging
3. clf;
4. R = 51;
5. **d = 0.8\*(rand(R,1) - 0.5); % Generate random noise**
6. m = 0:R-1;
7. s = 2\*m.\*(0.9.^m); % Generate uncorrupted signal
8. x = s + d’; % Generate noise corrupted signal
9. subplot(2,1,1);
10. **plot(m,d’,’r-’,m,s,’g--’,m,x,’b-.’);**
11. xlabel(’Time index n’);ylabel(’Amplitude’);
12. legend(’d[n] ’,’s[n] ’,’x[n] ’);
13. x1 = [0 0 x];x2 = [0 x 0];x3 = [x 0 0];
14. y = (x1 + x2 + x3)/3;
15. **subplot(2,1,2);**
16. plot(m,y(2:R+1),’r-’,m,s,’g--’);
17. legend(’y[n] ’,’s[n] ’);
18. xlabel(’Time index n’);ylabel(’Amplitude’);

## Questions:

### Q1.29 Run Program P1 5 and generate all pertinent signals.

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### Q1.30 What is the form of the uncorrupted signal s[n]? What is the form of the additive noise d[n]?

La señal incorrupta se obtiene de un crecimiento lineal con una caída exponencial. El ruido aditivo se obtiene de una secuencia distribuida entre -0.4 y 0.4.

### Q1.31 Can you use the statement x=s+d to generate the noise-corrupted signal? If not, why not?

No es posible porque un vector está en forma de columna y otro en forma de fila, por lo que no podría generarse tal como están.

### Q1.32 What are the relations between the signals x1, x2, and x3, and the signal x?

Las señales X1, X2 y X3 son extensiones de la señal X. La señal X1 se encuentra retrasada. La señal X2 es igual a la señal X y la señal X3 se encuentra adelantada por cierto tiempo de la señal X

### Q1.33 What is the purpose of the legend command?

El comando legend crea un identificador para las diferentes gráficas de la figura.

# Project 1.6 Generation of Complex Signals

Program P1 6 can be used to generate an amplitude modulated signal.

1. % Program P1\_6
2. % Generation of amplitude modulated sequence
3. clf;
4. n = 0:100;
5. **m = 0.4;fH = 0.1; fL = 0.01;**
6. xH = sin(2\*pi\*fH\*n);
7. xL = sin(2\*pi\*fL\*n);
8. y = (1+m\*xL).\*xH;
9. stem(n,y);grid;
10. **xlabel(’Time index n’);ylabel(’Amplitude’);**

## Questions:

### Q1.34 Run Program P1 6 and generate the amplitude modulated signal y[n] for various values of the frequencies of the carrier signal xH[n] and the modulating signal xL[n], and various values of the modulation index m.

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Interfaz de usuario gráfica, Aplicación

Descripción generada automáticamente

Interfaz de usuario gráfica, Aplicación

Descripción generada automáticamente

Una captura de pantalla de una computadora

Descripción generada automáticamente

Interfaz de usuario gráfica, Aplicación

Descripción generada automáticamente

### Q1.35 What is the difference between the arithmetic operators \* and .\* ?

El operador \* multiplica dos matrices de vectores usando producto de matrices.

El operador .\* calcula el producto escalar entre dos vectores.

As the frequency of a sinusoidal signal is the derivative of its phase with respect to time, to generate a swept-frequency sinusoidal signal whose frequency increases linearly with time, the argument of the sinusoidal signal must be a quadratic function of time. Assume that the argument is of the form (i.e. the angular frequency is ). Solve for the values of a and b from the given conditions (minimum angular frequency and maximum angular frequency).

Program P1 7 is an example program to generate this kind of signal.

1. % Program P1\_7
2. % Generation of a swept frequency sinusoidal sequence
3. n = 0:100;
4. a = pi/2/100;
5. **b = 0;**
6. arg = a\*n.\*n + b\*n;
7. x = cos(arg);
8. clf;
9. stem(n, x);
10. **axis([0,100,-1.5,1.5]);**
11. title(’Swept-Frequency Sinusoidal Signal’);
12. xlabel(’Time index n’);
13. ylabel(’Amplitude’);
14. grid; axis;

## Questions:

### Q1.36 Run Program P1 7 and generate the swept-frequency sinusoidal sequence x[n].

Interfaz de usuario gráfica, Aplicación

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### Q1.37 What are the minimum and maximum frequencies of this signal?

La mínima es de 0 Hz y la máxima es de 0.5Hz. Ambas se calculan con la fórmula:

### Q1.38 How can you modify the above program to generate a swept sinusoidal signal with a minimum frequency of 0.1 and a maximum frequency of 0.3?

Interfaz de usuario gráfica, Texto, Aplicación

Descripción generada automáticamente