

## Frank Martino - Proof of Skills Analytical Calculations Day 3

## **Q3** Analytical Calculations with personal calculator (TI-XX) and MATLAB or equivalent

Prove your skill set in using tools for analytical calculations.

Q3.3 Determine Components of a Sinusoid

I can analytically determine the amplitude, frequency, period and phase shift of a sinusoid (hint: for phase shift you will need a reference point which could be two different sinusoids plotted together!)

To prove my skills in analytically determining the amplitude, frequency, period, and phase shift of a sinusoid, I first used simulink to create a sine wave. I created two different sine waves one with default values and one modified values in order to make comparing the phase shift easier. The Simulink model and sine wave settings are shown on the next page.





	No. of the second se	
Block Parameters: Defalt Sine Wave		Block Parameters: Modified Sine Wave
Sine Wave		Sine Wave
Output a sine wave:	Modified Sine Wave	Output a sine wave:
O(t) = Amp*Sin(Freq*t+Phase) + Bias		O(t) = Amp*Sin(Freq*t+Phase) + Bias
Sine type determines the computational technique used. The parameters in the two types are related through:	Scope	Sine type determines the computational technique used. The parameters in the two types are related through:
Samples per period = 2*pi / (Frequency * Sample time)	Defalt Sine Wave	Samples per period = 2*pi / (Frequency * Sample time)
Number of offset samples = Phase $*$ Samples per period / (2*pi)		Number of offset samples = Phase * Samples per period / (2*pi)
Use the sample-based sine type if numerical problems due to running for large times (e.g. overflow in absolute time) occur.		Use the sample-based sine type if numerical problems due to running for large times (e.g. overflow in absolute time) occur.
Parameters		Parameters
Sine type: Time based  V		Sine type: Time based ~
Time (t): Use simulation time		Time (t): Use simulation time
Amplitude:		Amplitude:
<u>1</u> i		5
Bias:		Bias:
		0
Frequency (rad/sec):		Frequency (rad/sec):
		2i
Phase (rad):		Phase (rad):
Sample time:		-pi/2 -1.5708 :
0.0001		Sample time:
Interpret vector parameters as 1-D		0.001
OK Cancel Help Apply		Interpret vector parameters as 1-D
Defalt Blue Wave: B(t) =1*Sin(1t	+ <mark>0</mark> )	OK Cancel Help Apply
Amplitude: 1 unit		
Frequency: 1 rad/second		
Deviced (Devices and Of Fragment of	*0	
Period (Reciprocal Of Frequency	"2pi): 2 pi	
Phase shift (reference point is th	e origin (0,0)), formula (phase/	/trequency) 0/1 = 0 rads
Modified Yellow Wave: Y(t) = <mark>5</mark> *Sin( <mark>2</mark> t- <mark>pi/2</mark> )		
Amplitude: 5 units		
Erequency: 2 rad/second		
Deried (Deciprocal Of Fragueney)	*2ni): 1ni	

Phase shift (reference point is the origin (0,0)), formula (phase/frequency) (pi/2)/2 = pi/4 rads

We can also look at the graph itself to determine the components of their equations such as the amplitude, frequency, period, and phase shift. For example when looking at the graphs we see that from the center of the blue wave to its peak or minimum is 1 volt and 5 volts for the orange graph. So by definition the amplitudes are 1 volt and 5 volts respectively. While it's difficult to see the frequency in a graph we can use its relationship to the period to calculate it. By looking at the graph we can see that from peak to peak the period of the blue graph is 2pi and the period of the orange graph is shorter, 1 pi. We can then solve for the frequency by taking the reciprocal and multiplying by 2pi to put it in rad/seconds, doing so gets us 1 rad/second for the blue graph and 2 rad/seconds for the orange graph. The phase shift for a positive sinusoidal



graph is the distance of the midpoint to the left of the closest peak to the origin which would be 0 rads for the blue graph and 0.776 or  $\approx$  pi/4.