CENG 3331 Intro to Telecommunication and networks- Homework 1

Michael Lankford

1816337

Problem 1: T = $\frac{1}{f}$ → period = $\frac{1}{frequency}$

T = $\frac{1}{1000\ Hz}$ = .001 seconds

Problem 2: λ = vT = v ($\frac{1}{f}$) → wavelength = velocity * period = velocity($\frac{1}{frequency}$)

Note	C		D		E		F		G		A		B		C
Frequency	264		297		330		352		396		440		495		528
Frequency Difference		33		33		22		44		44		55		33	
Wavelength	1.250		1.110		1.000		0.938		0.833		0.750		0.667		0.625

λ = v ($\frac{1}{f}$) = 330 ($\frac{1}{264}$) = 1.250

λ = v ($\frac{1}{f}$) = 330 ($\frac{1}{297}$) = 1.110

λ = v ($\frac{1}{f}$) = 330 ($\frac{1}{330}$) = 1.000

λ = v ($\frac{1}{f}$) = 330 ($\frac{1}{352}$) = 0.938

λ = v ($\frac{1}{f}$) = 330 ($\frac{1}{396}$) = 0.833

λ = v ($\frac{1}{f}$) = 330 ($\frac{1}{440}$) = 0.750

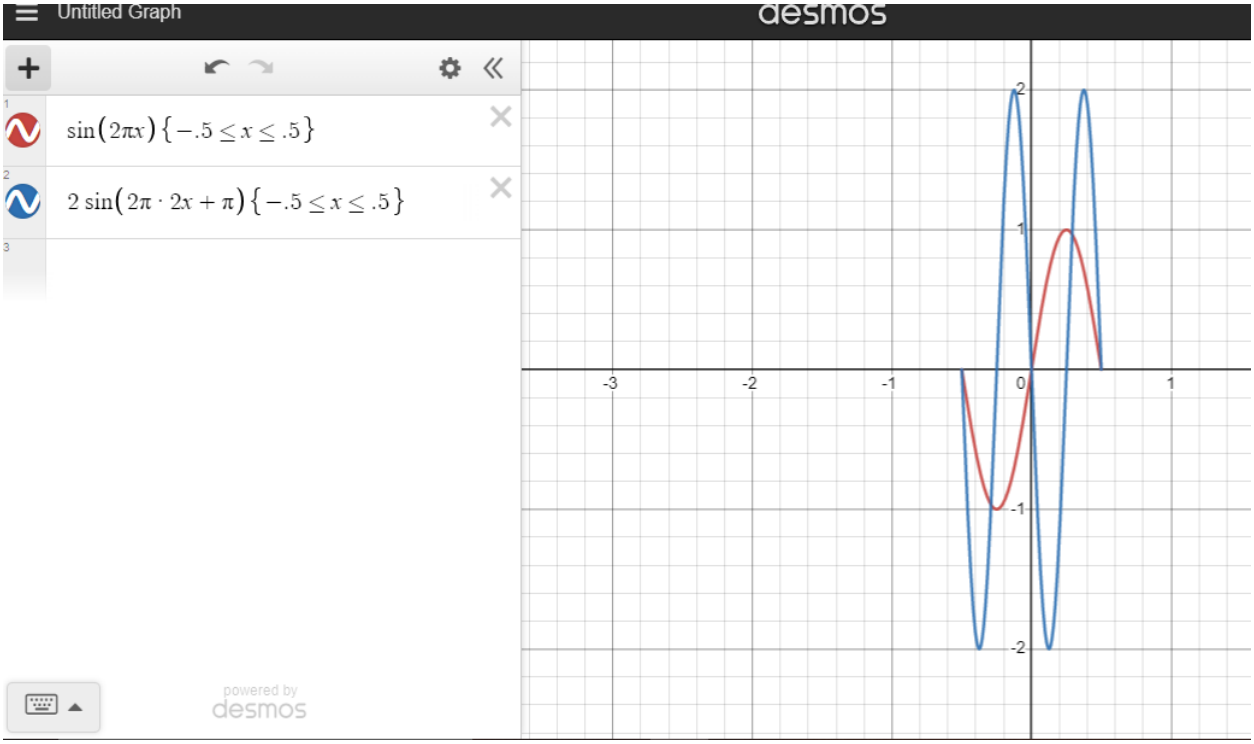
λ = v ($\frac{1}{f}$) = 330 ($\frac{1}{495}$) = 0.667

λ = v ($\frac{1}{f}$) = 330 ($\frac{1}{528}$) = 0.625

Problem 3: s(t) = A * sin(2π * f * t + φ) = sin wave = Amplitude * sin(2π * frequency * t + phase angle)

A = 2 f = 2 φ = π

s(t) = A * sin(2π * f * t + φ) = 2 * sin(2π * 2 * t + π)



Problem 4: s(t) = A* cos(2π * f * t + φ) = cos wave = Amplitude * cos(2π * frequency * t + phase angle) cos(t) = $\sin(\frac{\pi}{2} + t)$

(1+.1cos(5t))cos(100t) = cos(100t) + .1cos(5t)cos(100t) =

cos(100t) + .1 * .5(cos(5t+100t) + cos(5t-100t)) = cos(100t) + .05cos(105t) - .05cos(95t)

cos(100t) = s(t) = A * $\sin(2\pi * f * t + \frac{\pi}{2})$

A = 1 f = $\frac{100}{2\pi}$ = 15.915 φ = $\frac{\pi}{2}$

$.05\cos(105t) = s(t) = A * \sin(2\pi * f * t + \frac{\pi}{2})$

$A = .05 \qquad f = \frac{105}{2\pi} = 16.711 \qquad \varphi = \frac{\pi}{2}$

$.05\cos(95t) = s(t) = A * \sin(2\pi * f * t + \frac{\pi}{2})$

$A = .05 \qquad f = \frac{95}{2\pi} = 15.120 \qquad \varphi = \frac{\pi}{2}$

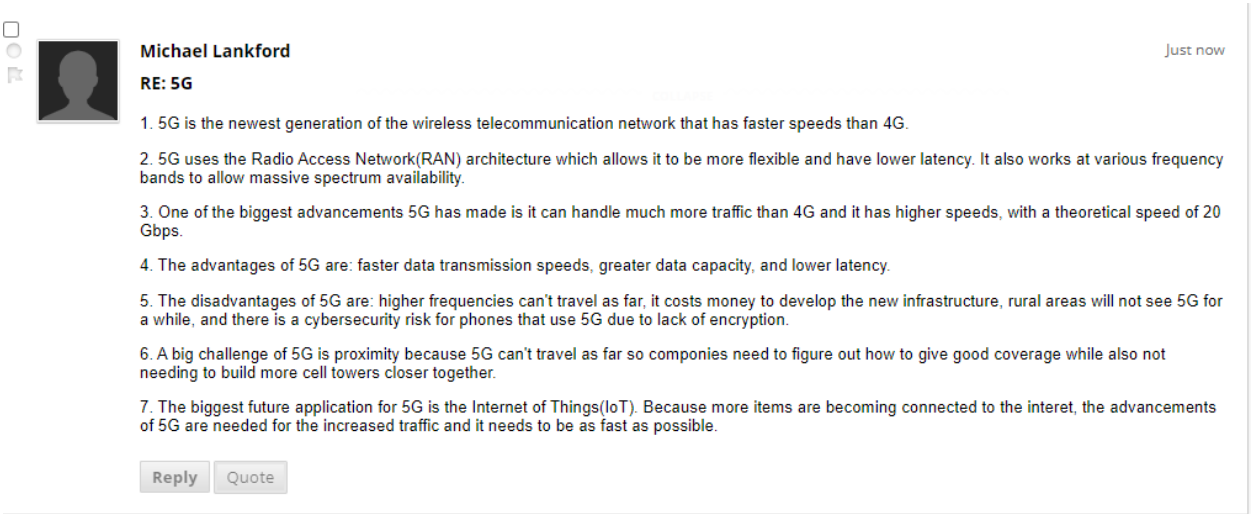
Problem 5: $G = 20 * \log_{10}(\frac{Vout}{Vin}) \rightarrow$ Gain $= 20 * \log_{10}(\frac{Voltage\ out}{Voltage\ in})$

$G = 20 * \log_{10}(\frac{Vout}{Vin}) \rightarrow 30 = 20 * \log_{10}(\frac{Vout}{Vin}) \rightarrow 1.5 = \log_{10}(\frac{Vout}{Vin}) \rightarrow \frac{Vout}{Vin} = 10^{1.5} = 31.6$ dB

Problem 6: $P_{dBW} = 10 * \log_{10}(\frac{Pw}{1\ W}) \rightarrow$ Power in dBW $= 10 * \log_{10}(\frac{Power\ in\ watt}{1\ Watt})$

$P_{dBW} = 10 * \log_{10}(\frac{20}{1\ Watt}) = 13.01$ dBW

Problem 7:



Michael Lankford Just now

RE: 5G

1. 5G is the newest generation of the wireless telecommunication network that has faster speeds than 4G.

2. 5G uses the Radio Access Network(RAN) architecture which allows it to be more flexible and have lower latency. It also works at various frequency bands to allow massive spectrum availability.

3. One of the biggest advancements 5G has made is it can handle much more traffic than 4G and it has higher speeds, with a theoretical speed of 20 Gbps.

4. The advantages of 5G are: faster data transmission speeds, greater data capacity, and lower latency.

5. The disadvantages of 5G are: higher frequencies can't travel as far, it costs money to develop the new infrastructure, rural areas will not see 5G for a while, and there is a cybersecurity risk for phones that use 5G due to lack of encryption.

6. A big challenge of 5G is proximity because 5G can't travel as far so componies need to figure out how to give good coverage while also not needing to build more cell towers closer together.

7. The biggest future application for 5G is the Internet of Things(IoT). Because more items are becoming connected to the interet, the advancements of 5G are needed for the increased traffic and it needs to be as fast as possible.

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Problem M1: $T = \frac{1}{f} \qquad RMS = \frac{1}{\sqrt{2}}(Amplitude)$

1) $T = \frac{1}{f} = \frac{1}{1} = 1$ second

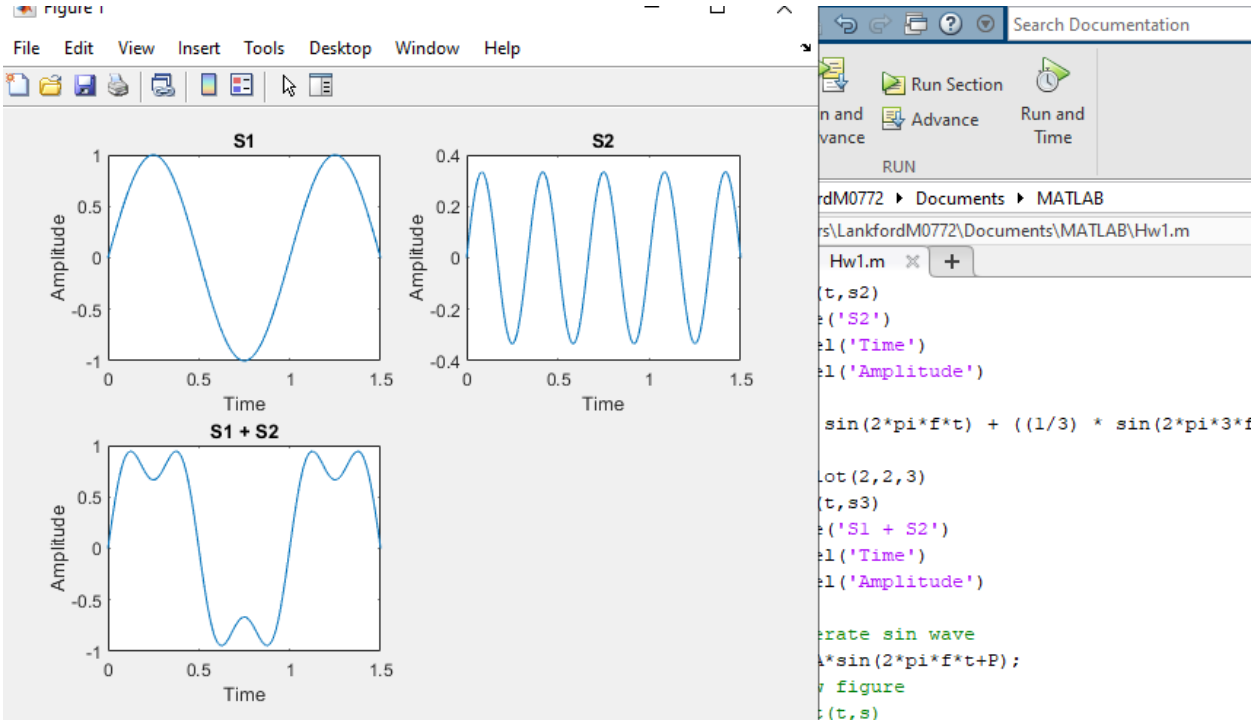
2) RMS = $\frac{1}{\sqrt{2}}(.5)$ = .354

3) T = $\frac{1}{f} = \frac{1}{2}$ = .5 seconds

4) The value of the signal at time = 0 is .720

Problem M2:

```
%Paremeter setting

A = 1; %Amplitude
f = 1; %frequency
P = 0; %Phase
time = 1.5; %time duration
N = 1000; %Sampling number
t = 0:time/(N-1):time;

s1 = sin(2*pi*f*t);
s2 = (1/3) * sin(2*pi*3*f*t);

subplot(2,2,1)
plot(t,s1)
title('S1')
xlabel('Time')
ylabel('Amplitude')

subplot(2,2,2)
plot(t,s2)
title('S2')
xlabel('Time')
ylabel('Amplitude')

s3 = sin(2*pi*f*t) + ((1/3) * sin(2*pi*3*f*t));

subplot(2,2,3)
plot(t,s3)
title('S1 + S2')
xlabel('Time')
ylabel('Amplitude')
```



Problem M3:

```
%Paremeter setting

A = 1; %Amplitude
f = 1; %frequency
P = 0; %Phase
time = 1.5; %time duration
N = 20000; %Sampling number
t = 0:time/(N-1):time;

%Notes
freqC = 264;
freqD = 297;
freqE = 330;
freqF = 352;
freqG = 396;
freqA = 440;
freqB = 495;
freqC2 = 528;

for freq = [freqE freqE freqF freqG freqG freqF freqE freqD freqC freqC freqD freqE freqE freqD freqD]
            x = A * sin(2*pi*freq*t);
             sound(x);
end
```