[Signal Analysis]

[vibration assignment]

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Find using MATLAB the resultant signal in the time-domain then find the frequency-domain for it, for the following cases:

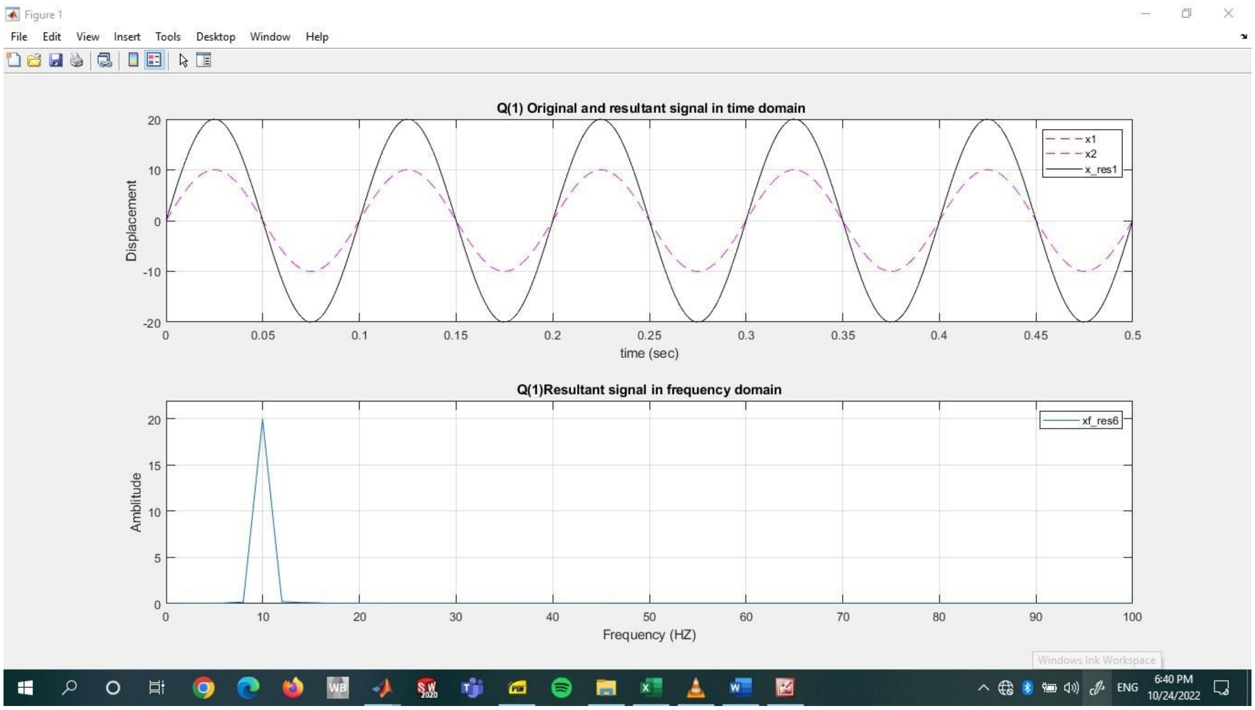
1) The resultant vector of two harmonics having the same amplitudes and frequencies.

Matlab Code

```
clc,clear,clf
%example [1]
%time domain
dt = 0.001;
t = 0:dt:0.5;
A1 = 10;
A2 = 10;
f1 = 10;%HZ
f2 = 10;%HZ
x1 = A1*sin(f1*2*pi*t);
x2 = A2*sin(f2*2*pi*t);
x_res1 = x1+x2;
subplot(2,1,1)
plot(t,x1,'--r',t,x2,'--m',t,x_res1,'k')
legend('x1','x2','x\_res1')
grid on
xlabel('time (sec)')
ylabel('Displacement')
title(' Q(1) Original and resultant signal in time domain')

%frequency domain
fs = 1/dt; %smpling rate
N = length(t); % #of samples
f = (0:N-1)*(fs/N);
xf_res1 = abs(fft(x_res1)*(2/N));
subplot(2,1,2)
plot(f,xf_res1)
legend('xf\_res6')
grid on
xlabel('Frequency (HZ)')
ylabel('Amblitude')
title('Q(1)Resultant signal in frequency domain')
axis([0 10*max([f1 f2]) 0 1.1*max([xf_res1])])
```

RESULTS



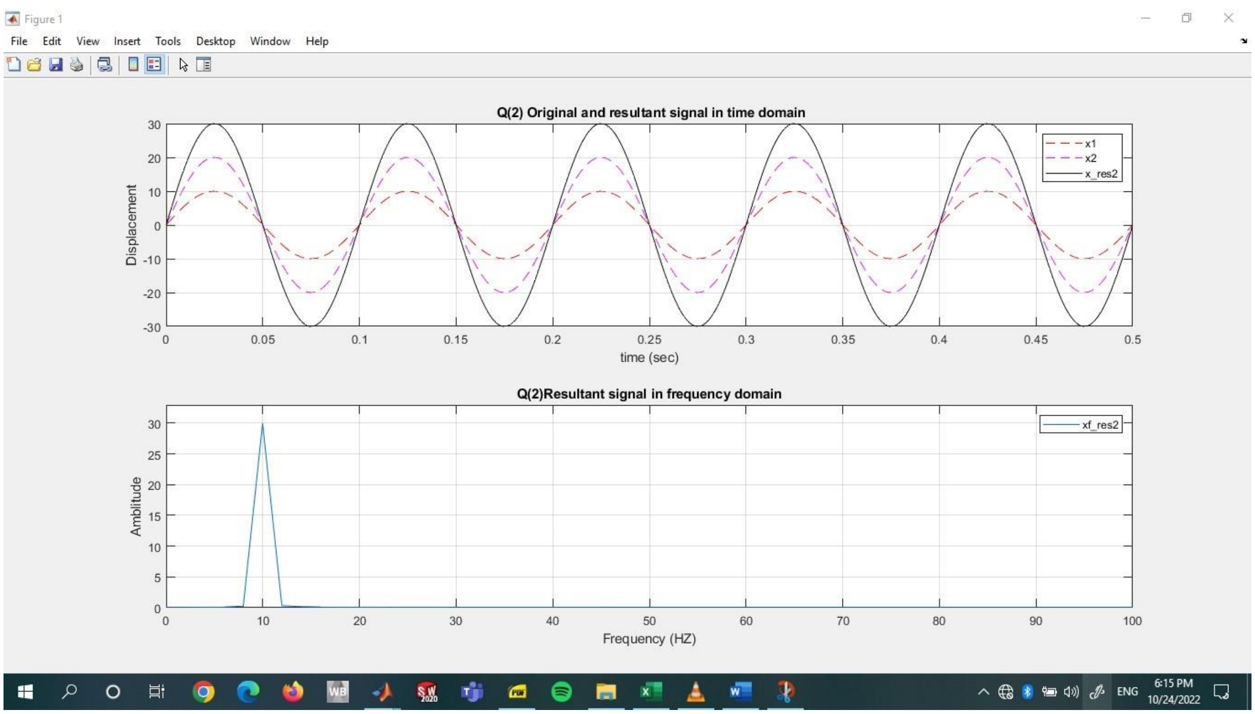
2) The resultant vector of two harmonics having different amplitudes and same frequencies.

Matlab Code

```
clc,clear,clf
%example [2]
%time domain
dt = 0.001;
t = 0:dt:0.5;
A1 = 10;
A2 = 20;
f1 = 10;%HZ
f2 = 10;%HZ
x1 = A1*sin(f1*2*pi*t);
x2 = A2*sin(f2*2*pi*t);
x_res2 = x1+x2;
subplot(2,1,1)
plot(t,x1,'--r',t,x2,'--m',t,x_res2,'k')
legend('x1','x2','x\_res2')
grid on
xlabel('time (sec)')
ylabel('Displacement')
title(' Q(2) Original and resultant signal in time domain')
```

```
%frequency domain
fs = 1/dt; %smpling rate
N = length(t); % #of samples
f = (0:N-1)*(fs/N);
xf_res2 = abs(fft(x_res2)*(2/N));
subplot(2,1,2)
plot(f,xf_res2)
legend('xf\_res2')
grid on
xlabel('Frequency (HZ)')
ylabel('Amblitude')
title('Q(2)Resultant signal in frequency domain')
axis([0 10*max([f1 f2]) 0 1.1*max([xf_res2])])
```

RESULTS



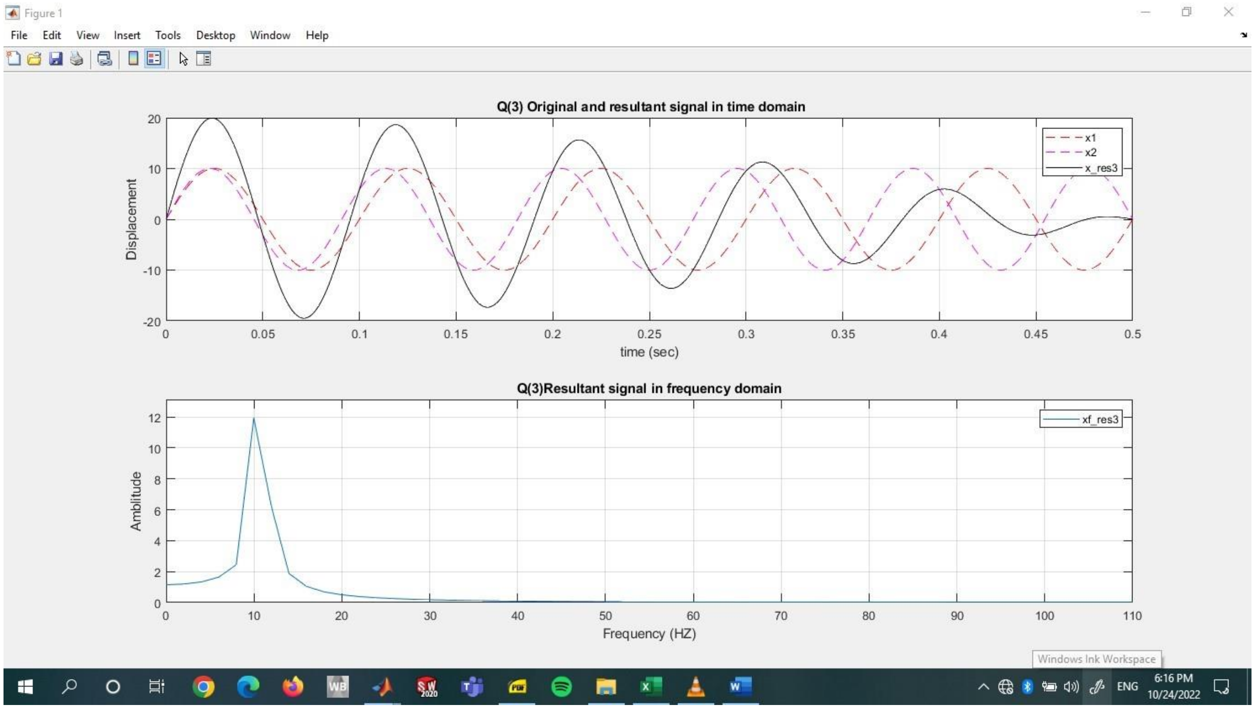
3) The resultant vector of two harmonics having same amplitudes and the first frequency is very close to the second frequency ($\omega \mathbf{1} \approx \omega \mathbf{2}$).

Matlab Code

```
clc,clear,clf
%example [3]
%time domain
dt = 0.001;
t = 0:dt:0.5;
A1 = 10;
A2 = 10;
f1 = 10;%HZ
f2 = 11;%HZ
x1 = A1*sin(f1*2*pi*t);
x2 = A2*sin(f2*2*pi*t);
x_res3 = x1+x2;
subplot(2,1,1)
plot(t,x1,'--r',t,x2,'--m',t,x_res3,'k')
legend('x1','x2','x\_res3')
grid on
xlabel('time (sec)')
ylabel('Displacement')
title(' Q(3) Original and resultant signal in time domain')

%frequency domain
fs = 1/dt; %smpling rate
N = length(t); % #of samples
f = (0:N-1)*(fs/N);
xf_res3 = abs(fft(x_res3)*(2/N));
subplot(2,1,2)
plot(f,xf_res3)
legend('xf\_res3')
grid on
xlabel('Frequency (HZ)')
ylabel('Amblitude')
title('Q(3)Resultant signal in frequency domain')
axis([0 10*max([f1 f2]) 0 1.1*max([xf_res3])])
```

RESULTS



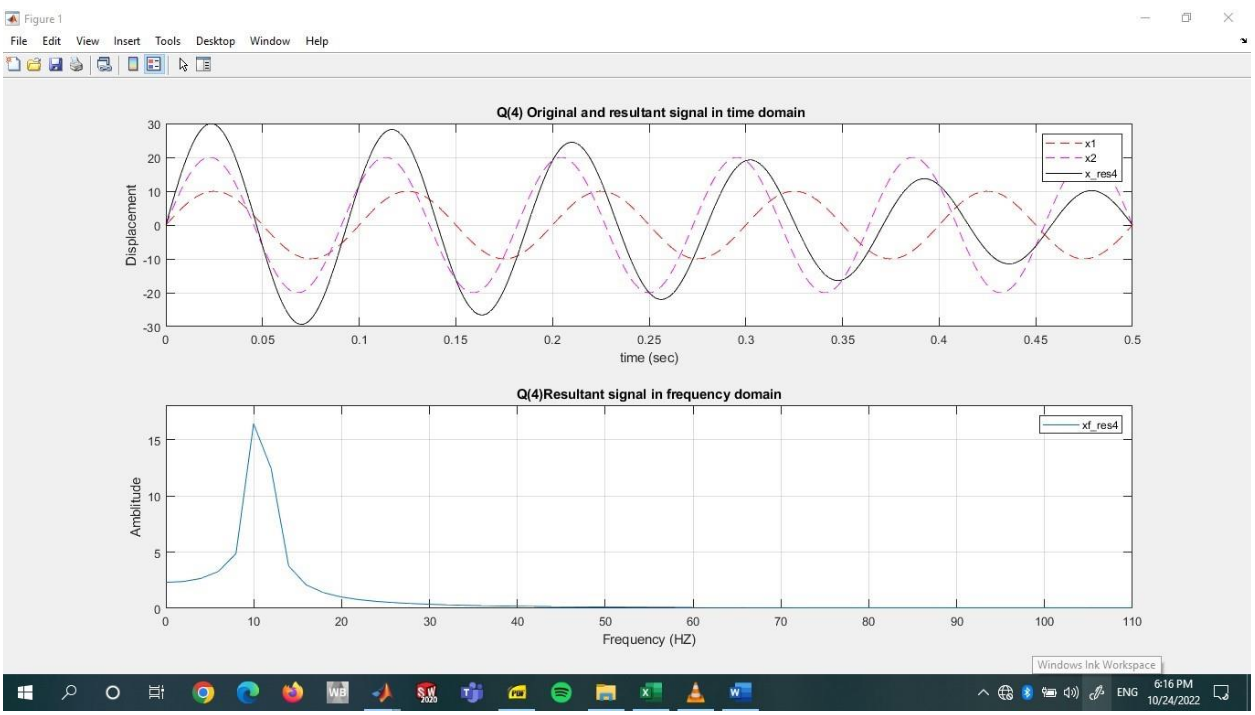
4) The resultant vector of two harmonics having different amplitudes and the first frequency is very close to the second frequency ($\omega\mathbf{1} \approx \omega\mathbf{2}$).

Matlab Code

```
clc,clear,clf
%example [4]
%time domain
dt = 0.001;
t = 0:dt:0.5;
A1 = 10;
A2 = 20;
f1 = 10;%HZ
f2 = 11;%HZ
x1 = A1*sin(f1*2*pi*t);
x2 = A2*sin(f2*2*pi*t);
x_res4 = x1+x2;
subplot(2,1,1)
plot(t,x1,'--r',t,x2,'--m',t,x_res4,'k')
legend('x1','x2','x\_res4')
grid on
xlabel('time (sec)')
ylabel('Displacement')
title(' Q(4) Original and resultant signal in time domain')
```

```
%frequency domain
fs = 1/dt; %smpling rate
N = length(t); % #of samples
f = (0:N-1)*(fs/N);
xf_res4 = abs(fft(x_res4)*(2/N));
subplot(2,1,2)
plot(f,xf_res4)
legend('xf\_res4')
grid on
xlabel('Frequency (HZ)')
ylabel('Amblitude')
title('Q(4)Resultant signal in frequency domain')
axis([0 10*max([f1 f2]) 0 1.1*max([xf_res4])])
```

RESULTS



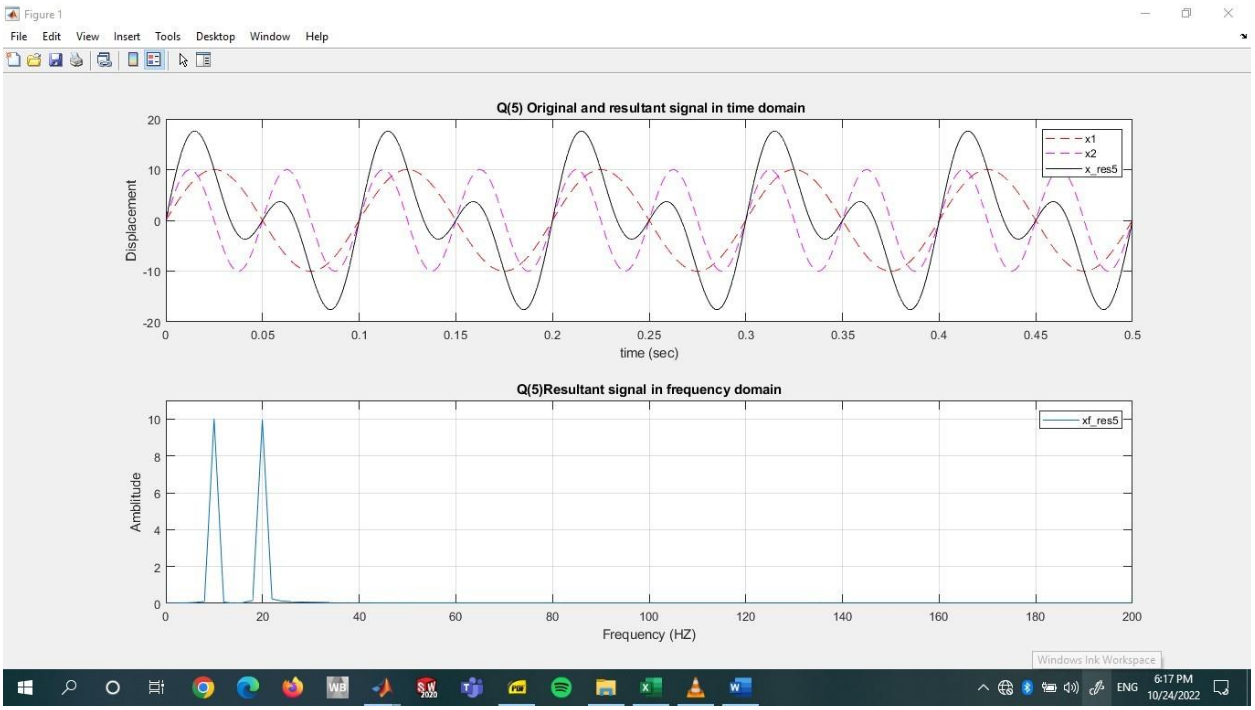
5) The resultant vector of two harmonics having same amplitudes and different frequencies ($\omega\mathbf{1} \gg \omega\mathbf{2}$).

Matlab Code

```
clc,clear,clf
%example [5]
%time domain
dt = 0.001;
t = 0:dt:0.5;
A1 = 10;
A2 = 10;
f1 = 10;%HZ
f2 = 20;%HZ
x1 = A1*sin(f1*2*pi*t);
x2 = A2*sin(f2*2*pi*t);
x_res5 = x1+x2;
subplot(2,1,1)
plot(t,x1,'--r',t,x2,'--m',t,x_res5,'k')
legend('x1','x2','x\_res5')
grid on
xlabel('time (sec)')
ylabel('Displacement')
title(' Q(5) Original and resultant signal in time domain')

%frequency domain
fs = 1/dt; %smpling rate
N = length(t); % #of samples
f = (0:N-1)*(fs/N);
xf_res5 = abs(fft(x_res5)*(2/N));
subplot(2,1,2)
plot(f,xf_res5)
legend('xf\_res5')
grid on
xlabel('Frequency (HZ)')
ylabel('Amblitude')
title('Q(5)Resultant signal in frequency domain')
axis([0 10*max([f1 f2]) 0 1.1*max([xf_res5])])
```

RESULTS



6) The resultant vector of two harmonics having different amplitudes and different frequencies ($\omega\mathbf{1} \gg \omega\mathbf{2}$).

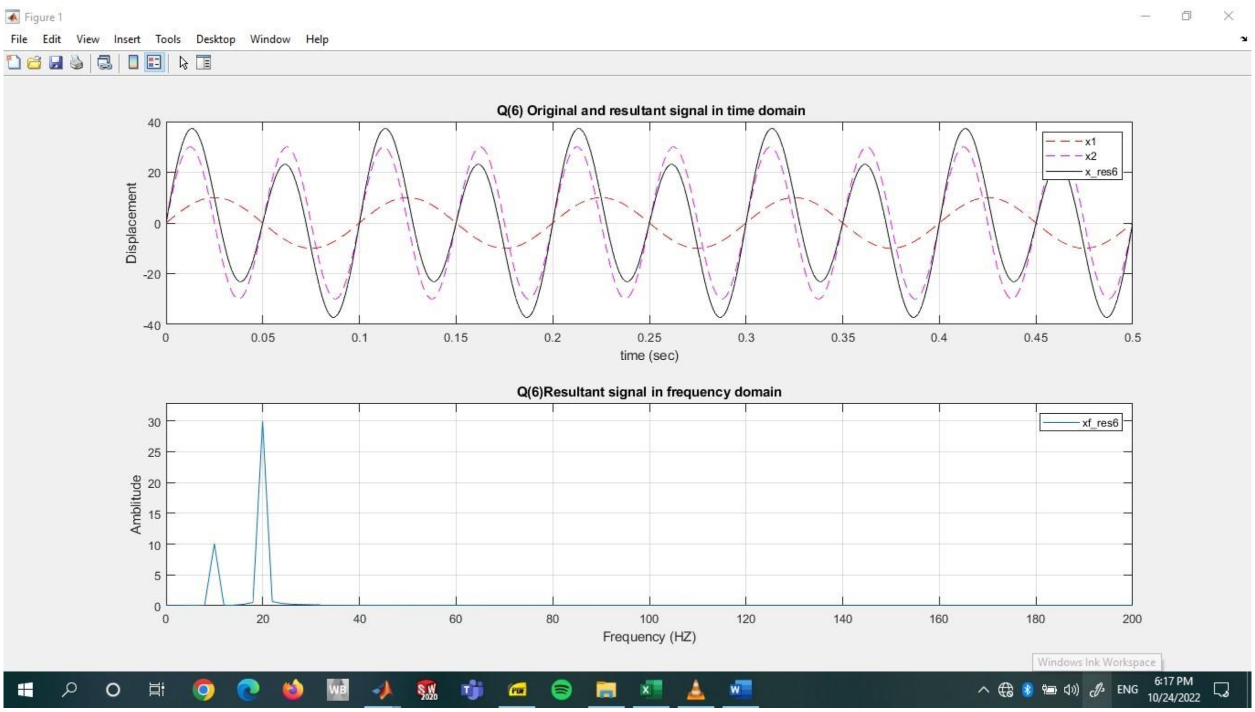
Matlab Code

```
clc,clear,clf
%example [6]
%time domain
dt = 0.001;
t = 0:dt:0.5;
A1 = 10;
A2 = 30;
f1 = 10;%HZ
f2 = 20;%HZ
x1 = A1*sin(f1*2*pi*t);
x2 = A2*sin(f2*2*pi*t);
x_res6 = x1+x2;
subplot(2,1,1)
plot(t,x1,'--r',t,x2,'--m',t,x_res6,'k')
legend('x1','x2','x\_res6')
grid on
xlabel('time (sec)')
ylabel('Displacement')
title(' Q(6) Original and resultant signal in time domain')

%frequency domain
```

```
fs = 1/dt; %smpling rate
N = length(t); % #of samples
f = (0:N-1)*(fs/N);
xf_res6 = abs(fft(x_res6)*(2/N));
subplot(2,1,2)
plot(f,xf_res6)
legend('xf\_res6')
grid on
xlabel('Frequency (HZ)')
ylabel('Amblitude')
title('Q(6)Resultant signal in frequency domain')
axis([0 10*max([f1 f2]) 0 1.1*max([xf_res6])])
```

RESULTS



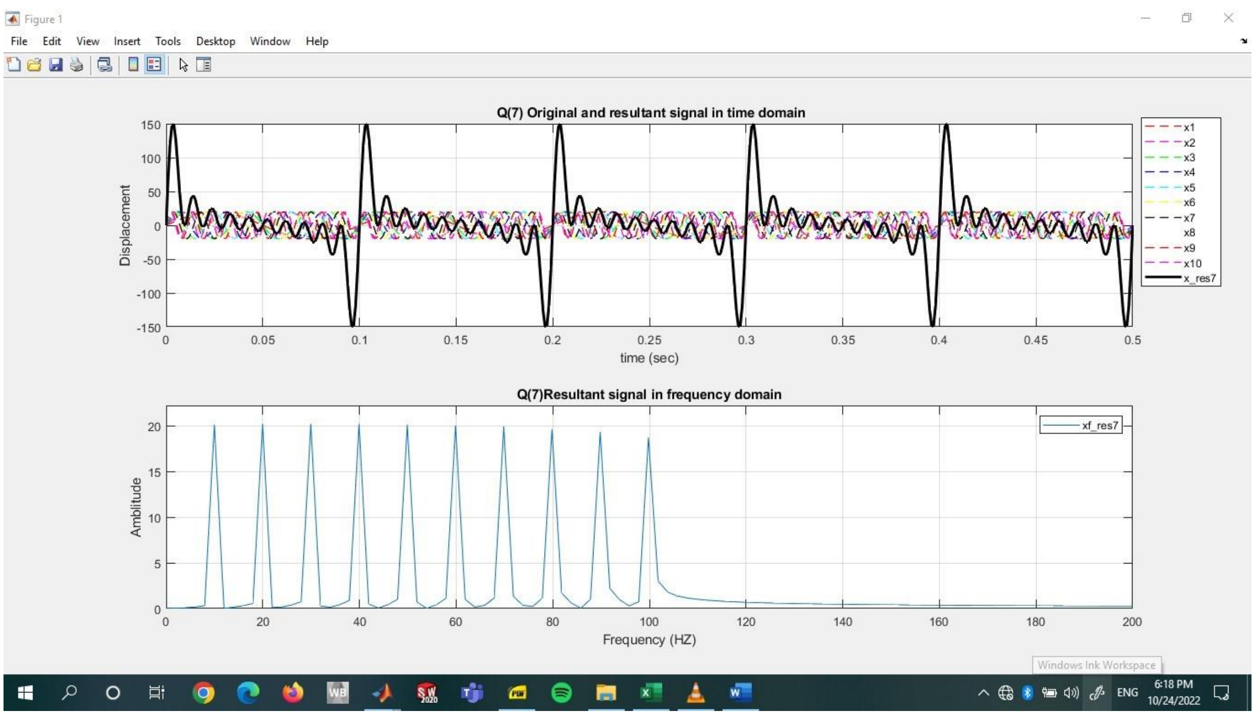
7) The resultant vector of 10 harmonics with same amplitudes and different frequencies as follows: ($\omega\mathbf{1} = \mathbf{10}$, $\omega\mathbf{2} = \mathbf{20}$, $\omega\mathbf{3} = \mathbf{30}$, … … . $\omega\mathbf{10} = \mathbf{100}$) $\boldsymbol{rad/sec}$.

Matlab Code

```
clc,clear,clf
%example [7]
%time domain
dt = 0.001;
t = 0:dt:0.5;
A1 = 20;
A2 = 20;
A3 = 20;
A4 = 20;
A5 = 20;
A6 = 20;
A7 = 20;
A8 = 20;
A9 = 20;
A10 = 20;
f1 = 10;%HZ
f2 = 20;%HZ
f3 = 30;%HZ
f4 = 40;%HZ
f5 = 50;%HZ
f6 = 60;%HZ
f7 = 70;%HZ
f8 = 80;%HZ
f9 =  90;%HZ
f10 = 100;%HZ
x1 = A1*sin(f1*2*pi*t);
x2 = A2*sin(f2*2*pi*t);
x3 = A3*sin(f3*2*pi*t);
x4 = A4*sin(f4*2*pi*t);
x5 = A5*sin(f5*2*pi*t);
x6 = A6*sin(f6*2*pi*t);
x7 = A7*sin(f7*2*pi*t);
x8 = A8*sin(f8*2*pi*t);
x9 = A9*sin(f9*2*pi*t);
x10 = A10*sin(f10*2*pi*t);
x_res7 = x1+x2+x3+x4+x5+x6+x7+x8+x9+x10;
subplot(2,1,1)
plot(t,x1,'--r',t,x2,'--m',t,x3,'--g',t,x4,'--b',t,x5,'--c',t,x6,'--
y',t,x7,'--k',t,x8,'--w',t,x9,'--r',t,x10,'--m','linewidth',1)
hold on
plot(t,x_res7,'k','linewidth',2)
hold off
legend('x1','x2','x3','x4','x5','x6','x7','x8','x9','x10','x\_res7')
grid on
xlabel('time (sec)')
ylabel('Displacement')
title(' Q(7) Original and resultant signal in time domain')
```

```
%frequency domain
fs = 1/dt; %smpling rate
N = length(t); % #of samples
f = (0:N-1)*(fs/N);
xf_res7 = abs(fft(x_res7)*(2/N));
subplot(2,1,2)
plot(f,xf_res7)
legend('xf\_res7')
grid on
xlabel('Frequency (HZ)')
ylabel('Amblitude')
title('Q(7)Resultant signal in frequency domain')
axis([0 10*max([f1 f2]) 0 1.1*max([xf_res7])])
```

RESULTS



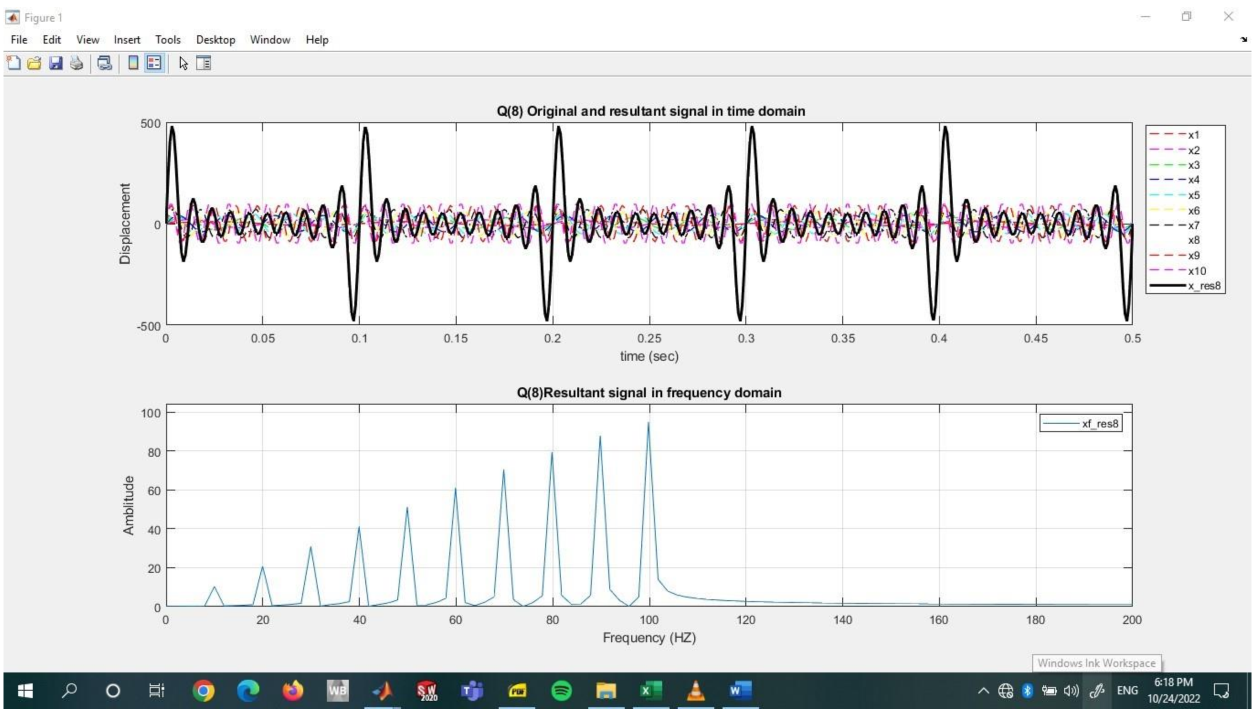
8) The resultant vector of 10 harmonics with different amplitudes and different frequencies as follows: ($\omega 1 = \mathbf{10}$, $\omega 2 = \mathbf{20}$, $\omega 3 = \mathbf{30}$, … … . $\omega \mathbf{10} = \mathbf{100}$) $\boldsymbol{rad/sec}$.

Matlab Code

```
clc,clear,clf
%example [8]
%time domain
dt = 0.001;
t = 0:dt:0.5;
A1 = 10;
A2 = 20;
A3 = 30;
A4 = 40;
A5 = 50;
A6 = 60;
A7 = 70;
A8 = 80;
A9 = 90;
A10 = 100;
f1 = 10;%HZ
f2 = 20;%HZ
f3 = 30;%HZ
f4 = 40;%HZ
f5 = 50;%HZ
f6 = 60;%HZ
f7 = 70;%HZ
f8 = 80;%HZ
f9 =  90;%HZ
f10 = 100;%HZ
x1 = A1*sin(f1*2*pi*t);
x2 = A2*sin(f2*2*pi*t);
x3 = A3*sin(f3*2*pi*t);
x4 = A4*sin(f4*2*pi*t);
x5 = A5*sin(f5*2*pi*t);
x6 = A6*sin(f6*2*pi*t);
x7 = A7*sin(f7*2*pi*t);
x8 = A8*sin(f8*2*pi*t);
x9 = A9*sin(f9*2*pi*t);
x10 = A10*sin(f10*2*pi*t);
x_res8 = x1+x2+x3+x4+x5+x6+x7+x8+x9+x10;
subplot(2,1,1)
plot(t,x1,'--r',t,x2,'--m',t,x3,'--g',t,x4,'--b',t,x5,'--c',t,x6,'--
y',t,x7,'--k',t,x8,'--w',t,x9,'--r',t,x10,'--m','linewidth',1)
hold on
plot(t,x_res8,'k','linewidth',2)
hold off
legend('x1','x2','x3','x4','x5','x6','x7','x8','x9','x10','x\_res8')
grid on
xlabel('time (sec)')
ylabel('Displacement')
title(' Q(8) Original and resultant signal in time domain')
```

```
%frequency domain
fs = 1/dt; %smpling rate
N = length(t); % #of samples
f = (0:N-1)*(fs/N);
xf_res8 = abs(fft(x_res8)*(2/N));
subplot(2,1,2)
plot(f,xf_res8)
legend('xf\_res8')
grid on
xlabel('Frequency (HZ)')
ylabel('Amblitude')
title('Q(8)Resultant signal in frequency domain')
axis([0 10*max([f1 f2]) 0 1.1*max([xf_res8])])
```

RESULTS



9) The resultant vector of 10 harmonics with different amplitudes and different frequencies randomly.

Matlab Code

```
clc,clear,clf
%example [9]
%time domain
dt = 0.001;
t = 0:dt:0.5;
A1 = 20;
A2 = 17;
A3 = 26;
A4 = 12;
A5 = 33;
A6 = 48;
A7 = 55;
A8 = 72;
A9 = 65;
A10 = 82;
f1 = 10;%HZ
f2 = 22;%HZ
f3 = 77;%HZ
f4 = 35;%HZ
f5 = 40;%HZ
f6 = 64;%HZ
f7 = 73;%HZ
f8 = 12;%HZ
f9 =  19;%HZ
f10 = 98;%HZ
x1 = A1*sin(f1*2*pi*t);
x2 = A2*sin(f2*2*pi*t);
x3 = A3*sin(f3*2*pi*t);
x4 = A4*sin(f4*2*pi*t);
x5 = A5*sin(f5*2*pi*t);
x6 = A6*sin(f6*2*pi*t);
x7 = A7*sin(f7*2*pi*t);
x8 = A8*sin(f8*2*pi*t);
x9 = A9*sin(f9*2*pi*t);
x10 = A10*sin(f10*2*pi*t);
x_res9 = x1+x2+x3+x4+x5+x6+x7+x8+x9+x10;
subplot(2,1,1)
plot(t,x1,'--r',t,x2,'--m',t,x3,'--g',t,x4,'--b',t,x5,'--c',t,x6,'--
y',t,x7,'--k',t,x8,'--w',t,x9,'--r',t,x10,'--m','linewidth',1)
hold on
plot(t,x_res9,'k','linewidth',2)
hold off
legend('x1','x2','x3','x4','x5','x6','x7','x8','x9','x10','x\_res7')
grid on
xlabel('time (sec)')
ylabel('Displacement')
title(' Q(9) Original and resultant signal in time domain')

%frequency domain
```

```
fs = 1/dt; %smpling rate
N = length(t); % #of samples
f = (0:N-1)*(fs/N);
xf_res9 = abs(fft(x_res9)*(2/N));
subplot(2,1,2)
plot(f,xf_res9)
legend('xf\_res9')
grid on
xlabel('Frequency (HZ)')
ylabel('Amblitude')
title('Q(9)Resultant signal in frequency domain')
axis([0 10*max([f1 f2]) 0 1.1*max([xf_res9])])
```

RESULTS