

$$1. x(t) \rightarrow \boxed{\text{A/D}} \rightarrow \boxed{\uparrow 3} \rightarrow \boxed{\text{H}(e^{j\omega})} \rightarrow \boxed{\downarrow 2} \rightarrow \boxed{\text{D/A}} \rightarrow y(t) \quad H(e^{j\omega}) = \begin{cases} 1 & \text{for } 0 \leq |\omega| < \frac{\pi}{3} \\ 0 & \text{for } \frac{\pi}{3} < |\omega| \leq \pi \end{cases}$$

Upsampling and downsampling in this order avoids aliasing.

PART	AFTER SAMPLING	AFTER FIRST	AFTER SECOND	FINAL
(a)	400&600	200&300	600&900	400&100
2.				
(b)	400&600	$\frac{1200}{1800} \rightarrow \frac{200}{800}$	100&400	100&400
(c)	400&600	$\frac{1600}{2400} \rightarrow \frac{400}{600}$	200&300	200&300

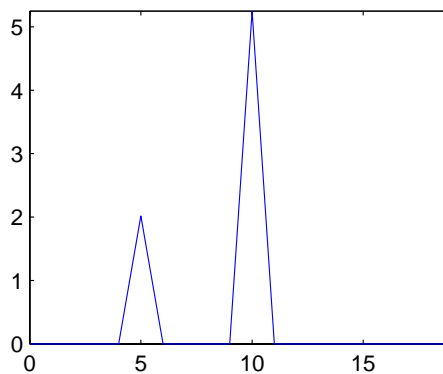
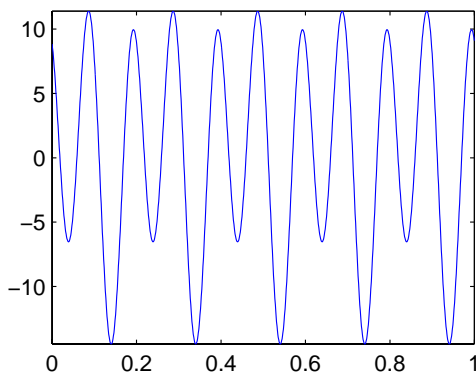
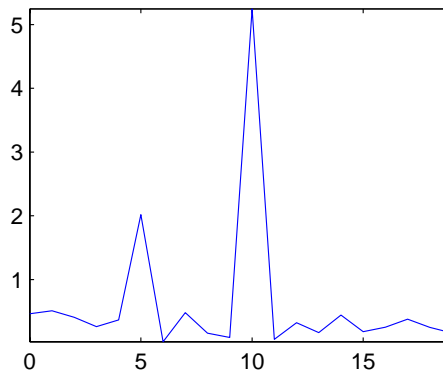
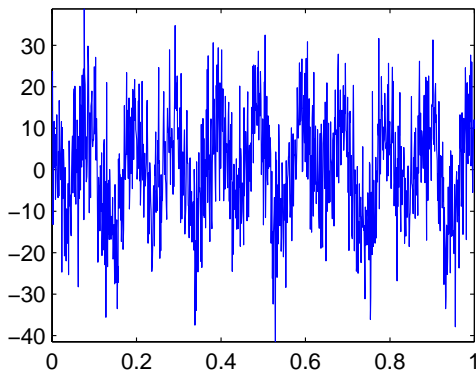
```
3a. T=linspace(0,1,1000);subplot(221),plot(T,X1),axis tight
```

```
3b. FX=fft(X1)/length(X1);subplot(222),plot(0:19,abs(FX(1:20))),axis tight
```

```
3c. FX(abs(FX)<0.9)=0;subplot(224),plot(0:19,abs(FX(1:20))),axis tight
```

```
3d. subplot(223),plot(T,length(X1)*real(ifft(FX))),axis tight
```

The actual signal is $4 \sin(10\pi t) + 10 \cos(20\pi t + 0.6435)$.



```
4a. T=[1000:1199]/44100;subplot(221),plot(T,X2(1000:1199)),axis tight
```

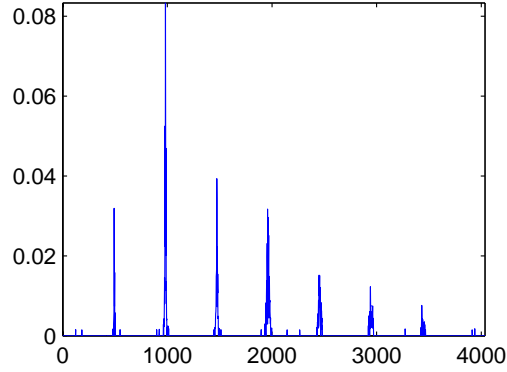
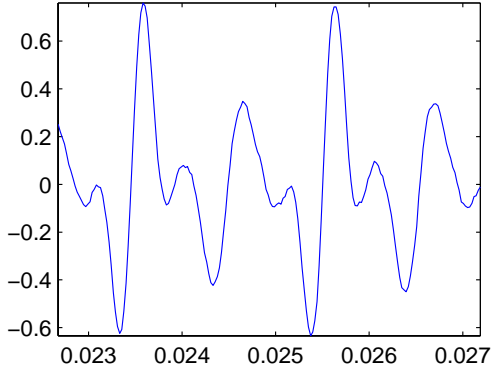
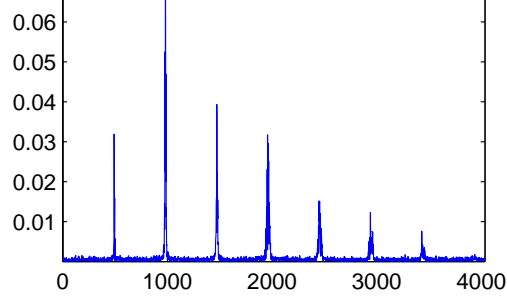
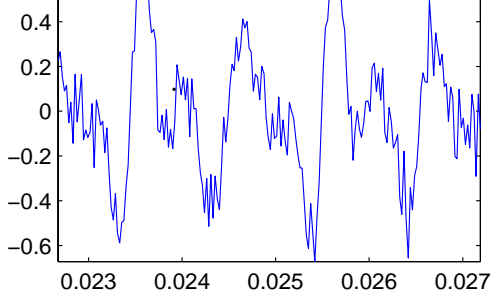
```
4b. F=[0:2999]*44100/32768;
```

```
4b. FX=fft(X2)/length(X2);subplot(222),plot(F,abs(FX(1:3000))),axis tight
```

```
4c. FX(abs(FX)<0.0015)=0;subplot(224),plot(F,abs(FX(1:3000))),axis tight
```

```
4d. Z=length(X2)*real(ifft(FX));subplot(223),plot(T,Z(1000:1199)),axis tight
```

Listen to the unfiltered and filtered trumpet signals—noise is gone! Plots: next page.



```

5a. T=[1000:1199]/44100;subplot(221),plot(T,X3(1000:1199)),axis tight
5b. F=[0:2999]*44100/32768;
5b. FX=fft(X3)/length(X3);subplot(222),plot(F,abs(FX(1:3000))),axis tight
5c. I=[301:350 601:700 951:1000 1251:1350 1601:1651 1901:2000 2250:2300];
5c. I=[I 2501:2600 2851:2950];FX([I length(X3)+2-I])=0;
5c. subplot(224),plot(F,abs(FX(1:3000))),axis tight
5d. Z=length(X3)*real(ifft(FX));subplot(223),plot(T,Z(1000:1199)),axis tight

```

Listen to the unfiltered and filtered trumpet signals—one trumpet is gone!

