1.7 (Worked in class)

(a) \( F_{\text{man}} = 10 \text{kHz} \Rightarrow F_s \geq 2F_{\text{man}} = 20 \text{kHz} \)

(b) For \( F_s = 8 \text{kHz} \), \( F_{\text{fold}} = 4 \text{kHz} \)
\[ \Rightarrow 5 \text{kHz} \text{ will alias to 3kHz} \]

(c) \( F = 9 \text{kHz} \) will alias to 1kHz

1.9

(a) \( F_{\text{man}} = 360 \text{Hz} \), \( F_N = 2F_{\text{man}} = 720 \text{Hz} \)

(b) \( F_{\text{fold}} = \frac{F_s}{2} = 300 \text{Hz} \)

(c) \[ x(n) = x_a(nT) \]
\[ = x_a(n/f_s) \]
\[ = \sin(480\pi n/600) + 3\sin(720\pi n/600) \]
\[ x_0(n) = \sin(6\pi n/5) - 3\sin(12\pi n/5) \]
\[ = -2\sin(12\pi n/5) \]

Therefore, \( w = 6\pi/5 \)

(d) \( y_a(t) = x(F_s t) = -2\sin(480\pi t) \)
1.15 See Matlab solution:

(a) With \( F_s = 5 \text{kHz} \), \( F_{\text{fold}} = 2.5 \text{kHz} \)

4.5 kHz is aliased to 500 kHz
3 kHz is aliased to 2 kHz

(b)  
(1) \( f_0 = \frac{2}{50} = \frac{1}{25} \)  \( N_D = 25 = \text{Period} \)

(2) Effectively \( F_s = 25 \)

\( f_0 = \frac{2}{25} \) However \( N_D = 25 = \text{Period} \)
2.6(a)

\[ y[n] = x[n^2] \]

Let \( x_1[n] = x[n-A] \) = delayed input

\[ y_1[n] = T[x_1[n]] = x_1[n-A]^2 \]

\( y_2[n-A] = \neq y_1[n] \)

\( \implies \) time invariant

\( \neq \) time invariant

\( \text{delayed output} \)

\( \text{Response to delayed input} \)

\[ y_2[n] \neq y_2[n] \]

\( \text{time invariant} \)

\( \text{(Time Varying)} \)
2.7 (a) Static, nonlinear, Time invariant, Causal, Stable
(b) Dynamic, linear, time invariant, non-causal unstable
\[ \text{If } h(k) = u(k), \quad y(n) \to \infty \text{ as } n \to \infty \]
(c) Static, linear, time invariant, Causal, Stable

2.10 Since the system is time invariant, if it is linear, we know that
\[ y_3(n) = h(n-3) \]
\[ \Rightarrow y_3(n) = h(n-3) \]
Furthermore, we would have,
\[ y_2(n) = 3 h(n-2) \]
and thus \[ y_2(n) = 3 h(n-2) \]
\[ = 3 y_3(n+1) \]
However \[ y_2(n) \neq 3 y_3(n+1) \]
Therefore the system is non-linear.

\[ \begin{array}{c@{\,}c@{\,}c}
0 & 1 & 2 \\
0 & 0 & 0 \\
\end{array} \]

Still we have \( h(n) \) is non-causal
A system is BIBO stable if and only if a bounded input produces a bounded output. 

$$y(n) = \sum_k h(k) x(n-k)$$

$$|y(n)| \leq \sum_k |h(k)| |x(n-k)|$$

$$\leq M_n \sum_k |h(k)|$$

Where $$|x(n-k)| \leq M_n$$. Therefore, $$|y(n)| < \infty$$ for all $$n$$, if and only if 

$$\sum_k |h(k)| < \infty$$