大同大學 九十 學年度研究所碩士班入學考試試題

考試科目：**數位信號處理**　　所別：**電機工程研究所**　　第 1/2 頁

註:本次考試 不可以參考自己的書籍及筆記； 不可以使用字典； 不可以使用計算器。

1. Consider the discrete-time complex exponential sequence $x[n]=e^{j\omega_0 n}$. For each of the following statements, determine whether it is true or false. (是非題，毋需證明，答錯倒扣。) <10%>

   a) The frequency index ω_0 is dimensionless.
   b) $x[n]$ is indistinguishable from $x_k[n]=e^{j(\omega_0+2\pi k)n}$, where k is an integer.
   c) $x[n]$ must be a periodic sequence.
   d) $x[n]$ is referred to has a higher frequency (i.e., the sequence oscillates more rapidly) whenever ω_0 increases.

2. Determine whether the system T is (a) linear, (b) time-invariant, (c) stable, and (d) causal? Please justify your answers. <20%>

$$T(x[n])=\sum_{k=n-n_0}^{n+n_0} x[k]$$

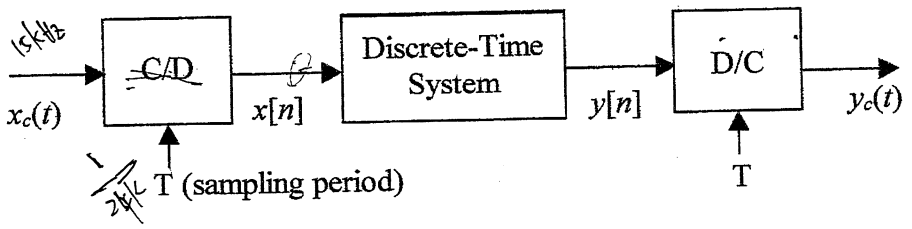
3. Consider a causal **linear time-invariant** system with the system function $\frac{1-z^{-1}}{1+0.8z^{-1}}$ and the input $x[n]=(\frac{1}{5})^n u[n]$. (Note: $u[n]$ denotes the unit step sequence) <20%>

   (a) Find the impulse response of the system.
   (b) Find the frequency response of the system.
   (c) Write the difference equation that characterizes the system.
   (d) Find the output $y[n]$ for all values of n.

4. Let $X(e^{j\omega})$ denote the discrete-time Fourier transform of $x[n]$. Please show that $X(e^{j\omega})=X^*(e^{-j\omega})$ for any **real** sequence $x[n]$. <8%>

5. (a) Concisely state the **sampling theorem.** <6%>
   (b) Let the continuous-time signals $x(t)$ and $y(t)$ be band-limited to 2 kHz and 3 kHz, respectively. Determine the critical sampling frequencies for each of the following signals: <9%>
   (i) $x(2t)$,
   (ii) $x(t)y(t)$,
   (iii) $x(t)*y(t)$.

6. Consider the system shown below, with the discrete-time system an ideal lowpass filter with cutoff frequency $\pi/2$.



   (a) If $x_c(t)$ is bandlimited to 15 kHz, what is the maximum value of T to guarantee the effective continuous-time system also be an ideal lowpass filter? <7%>
   (b) If 1/T= 24 kHz, what will the cutoff frequency (in Hz) of the effective continuous-time filter be? <5%>

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考試科目：數位信號處理　　所別：電機工程研究所　　第 2/2 頁

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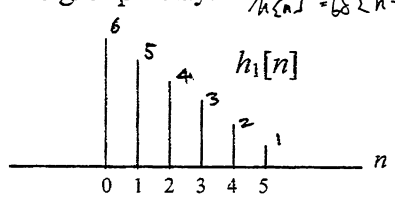
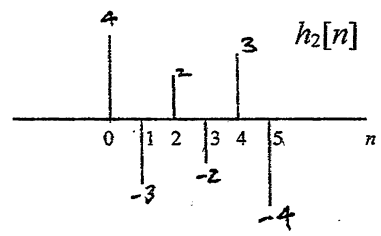
7. For the two impulse responses shown below, determine which one is a generalized linear-phase filter and find its group delay. <6%>





8. Consider the block diagram shown below, where the distorting system $H_d(z)$ is a stable and non-minimum-phase system with system function $H_d(z)=\dfrac{(1-3z^{-1})(1-0.25z^{-1})}{(1-0.75z^{-1})(1-0.5z^{-1})}$, $|z|>0.75$. Find a **stable and causal** compensating system that can achieve $|S_c(e^{j\omega})|=|S(e^{j\omega})|$, i.e., the compensation of frequency-response magnitude. <9%>