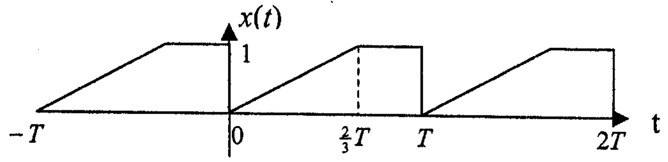
國立中央大學九十二學年度碩士班考試入學招生試題卷　　共 2 頁 第 1 頁

系所別：電機工程學系 丙組　科目：信號與系統

1. (A) (5 %) Calculate the RMS (root mean-square) value of the periodical signal $x(t)$ shown in the figure shown below. (B) (2 %) What is the RMS value of $x(7t)$? (C) (3 %) What is the RMS value of $5\,x(-t)$?

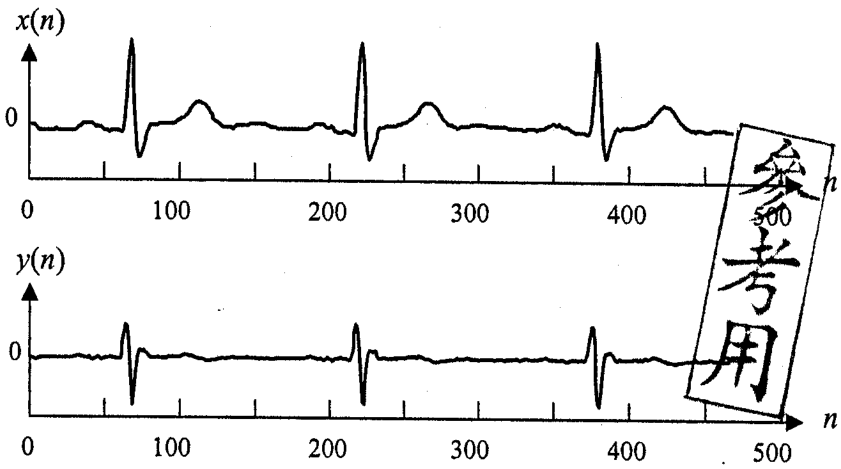


2. Let $x(n)$ and $y(n)$, whose waveforms are shown below, be the input and output, respectively, of a discrete-time LTI (linear time-invariant) system.

   (A) (3 %) Which of the following is the system function? (a) High-pass filtering (b) Low-pass filtering (c) All-pass filtering (d) Averaging (e) Integration.

   (B) (2 %) Which of the following equations best describes the relationship between the digital signals $x(n)$ and $y(n)$ shown below? (a) $y(n) = x(n) - x(n-1)$ (b) $y(n) - y(n-1) = x(n)$ (c) $y(n) = x(n) + x(n-1)$ (d) $y(n) + y(n-1) = x(n)$

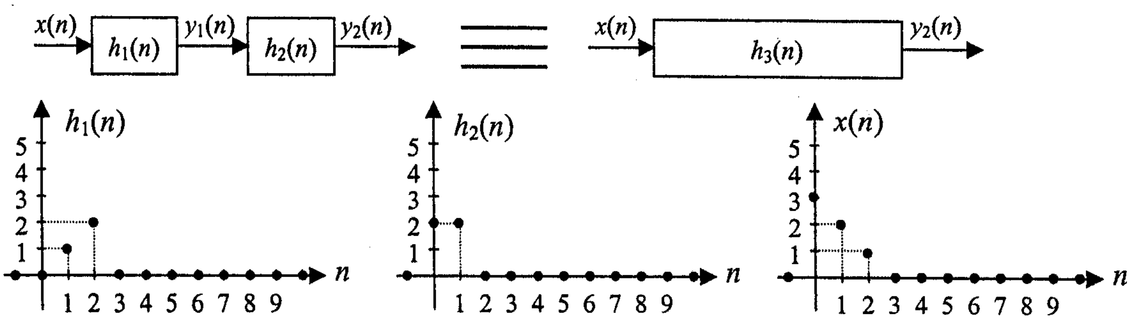
   (C) (5 %) Explain your answer to question (B).



3. Let $h_1(n)$ and $h_2(n)$ be the unit impulse responses of two LTI (linear time-invariant) systems. The two systems are connected as shown in the figure below. $x(n)$ is the input to the first system. The waveforms of $x(n)$, $h_1(n)$ and $h_2(n)$ are also shown below.

   (A) (5 %) Depict the waveforms of $y_1(n)$ and $y_2(n)$, the output signals of the two systems.

   (B) (5 %) Depict the waveform of $h_3(n)$, the equivalent system of the cascade of the first and the second systems.



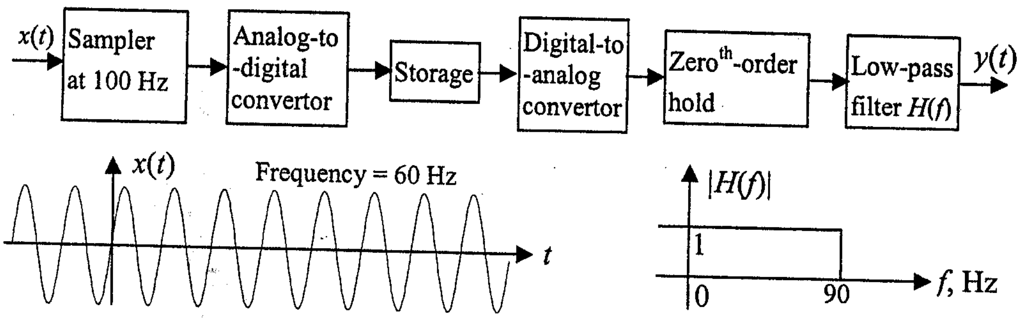
注意：背面有試題

4. Calculate the Fourier Transforms $X(j\omega)$ of signal $x(t)$ and depict $X(j\omega)$.

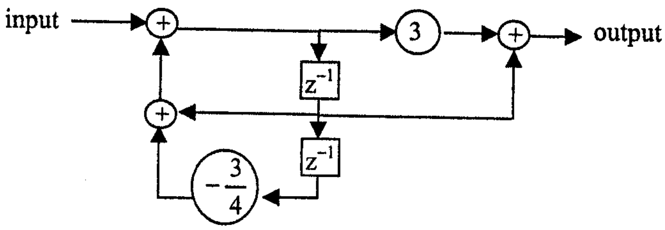
(A) (5 %) $x(t)=\begin{cases}1, & |t|\le T\\ 0, & |t|>T\end{cases}$　(B) (5 %) $x(t)=\begin{cases}\cos(\omega_0 t), & |t|\le T\\ 0, & |t|>T\end{cases}$　(Note: $\omega_0=\frac{4\pi}{T}$)

5. (10 %) Find the Inverse Fourier Transform of $X(j\omega)=\dfrac{-j\omega+2}{(j\omega)^2+9j\omega+20}$.

6. A junior engineer designs a system, as shown below, that is intended to store an analog signal in a digital form for later reconstruction. The first stage in the system is a sampler with a 100-Hz sampling rate (i.e., 100 samples per second). Both the analog-to-digital converter and the digital-to-analog converter in this system are nearly perfect. For the last stage in the system, he uses a low-pass filter with 90 Hz cutoff frequency, because he knows that the highest frequency in the input signal $x(t)$ is less than 90 H. The frequency response $H(f)$ of the low-pass filter is almost ideal. Now, he is testing his design with an 80-Hz sinusoidal signal as $x(t)$. (A) (5 %) What signal will he get in the reconstructed signal $y(t)$. (B) (5 %) Explain why he will get such a signal. (C) (5 %) How can the system be modified or changed in order to get correct reconstruction.



7. The signal-flow diagram of a digital filter is shown below. (A) (5 %) Determine the transfer function of this filter. (B) (5 %) Mark the poles and zero in the z-domain. (C) (5 %) Find the difference-equation description of this filter. (D) (5 %) Is this an FIR or an IIR filter? Why?



8. $H(s)=\dfrac{1}{s^2+\sqrt{2}\,s+1}$ is the characteristic of an analog low-pass filter.

(A) (5 %) Calculate the −3 dB frequency.

(B) (5 %) Express the phase response $\angle H(j\omega)$ as a function of ω, the angular frequency.

(C) (5 %) Use bilinear transformation to design a digital filter $H(z)$ from $H(s)$. What is the transfer function $H(z)$?

(Bilinear transformation: $s=\dfrac{2}{T}\dfrac{z-1}{z+1}$, where T is the reciprocal of the sampling frequency.)