所別：電機工程學系碩士班 丙組(一般生) 科目：信號與系統

Question 1: (20%)

Given a highpass filter for processing discrete-time input, its frequency response is

$$H_{hp}(e^{j\omega}) = \begin{cases} e^{-j\omega n_d}, & \omega_c < |\omega| < \pi \\ 0, & |\omega| < \omega_c \end{cases}$$, where ω_c is the ideal cutoff frequency.

Please calculate its inverse Fourier transform, $h_{hp}[n]$.

Question 2: (20%)

Consider an LTI system, h[n], with frequency response

$$H(e^{j\omega}) = \frac{1-e^{-j3\omega}}{1+\frac{1}{2}e^{-j6\omega}}, \qquad -\pi<\omega<\pi$$

For a given input x[n] as

$$x[n] = \sin\left(\frac{\pi n}{3}\right)$$

Please determine the system output y[n], where y[n] is the convolution of x[n] and h[n].

Question 3: (20%)

For a causal sequence whose z-transform can be represented as

$$X(z) = \frac{(1+2z)(1+3z^{-1})}{(1-5z^{-1})}$$

Please determine its inverse z-transform, x[n].

Question 4: (20%)

The system function H(z) of a causal linear time-invariant system has the pole-zero configuration shown in Fig. 4.1. It is also known that H(z) =6 when z=1.

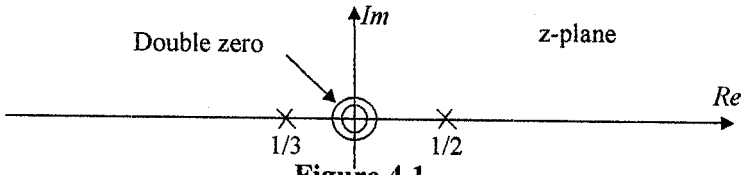

Figure 4.1

Answer the following questions:

(a) (5%) Determine H(z).

(b) (5%) Determine the impulse response h[n] of the system.

(c) Determine the response of the system to the following input signals:

(i) (5%) x[n] = u[n] – 0.5·u[n-1].

(ii) (5%) the response x[n] obtained from sampling the continuous-time signal.

$$x(t) = 50 + 10\cos 20\pi t + 30\cos 40\pi t$$

at a sampling frequency $\Omega s=2\pi(40)$ rad/s.

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Question 5: (20%)

The following shows the block diagram of interpolator and decimator.

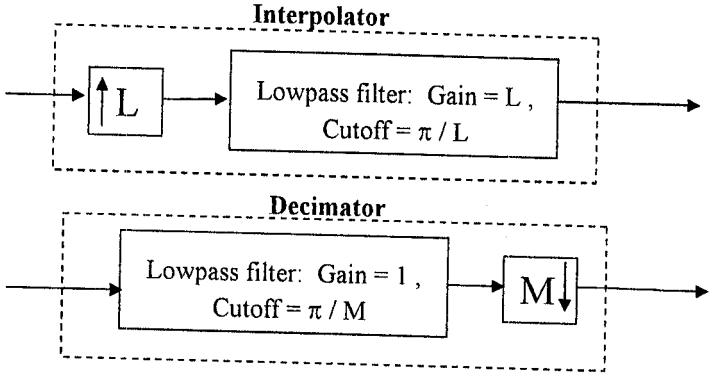

Figure 5.1

If we input a discrete-time signal $x[n] = \frac{3\sin[(3/2)n]}{\pi n}$ to the interpolator-decimator system (shown in Fig. 5.2) with L=2 and M=5, **please determine the output y[n].**

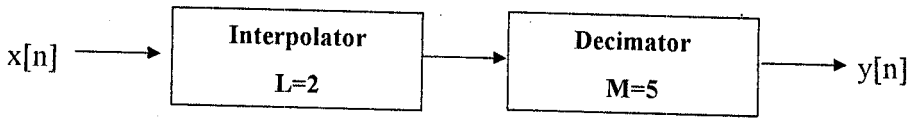

Figure 5.2