國立中央大學106學年度碩士班考試入學試題

所別：電機工程學系 碩士班 系統與生醫組(一般生) 共1頁 第1頁

科目：信號與系統

本科考試禁用計算器 ＊請在答案卷 內作答

1. For a system $h(t)$, the input $x(t) = e^{-5t}u(t)$ and the output $y(t) = e^{-t}u(3t)$. Determine the impulse response of its inverse system $h^{inv}(t)$. (10%)

2. Find the frequency-domain representation for signal $x(t) = \frac{d}{dt}\left\{e^{-3t}u(t-2)\right\} * \left\{e^{-2t}u(3t)) \times e^{-jt}\right\}$. (20%)

3. Find the Fourier transform of $x(t) = te^{-5|t-2|}$. (10%)

4. Evaluate $\int_{-\infty}^{\infty} \frac{25}{(jt+4)^2} dt$. (10%)

5. (a) For a system with the relation between input $x[n]$ and output $y[n]$ represented as $y[n] - \frac{12}{35}y[n-1] + \frac{1}{35}y[n-2] = x[n] - 3x[n-1]$, please find the causal system $h[n]$ to achieve $x[n] * h[n] = y[n]$ of this system. (7%)

(b) Find the z-transform of the following signal $x[n] = \left(\left(\frac{-1}{3}\right)^n u[n]\right) * \left(n\left(\frac{1}{4}\right)^n u[n]\right)$. (8%)

6. Please prove the following discrete-time Fourier transform (DTFT) properties:

(a) $x[n] * y[n] \xrightarrow{DTFT} X(e^{j\Omega}) \cdot Y(e^{j\Omega})$. (5%) (b) $\sum_{n=-\infty}^{\infty} |x[n]|^2 = \frac{1}{2\pi}\int_{-\pi}^{\pi} \left|X\left(e^{j\Omega}\right)\right|^2 d\Omega$. (5%)

(c) $x[n-n_d] \xrightarrow{DTFT} e^{-j\Omega n_d} X(e^{j\Omega})$. (5%)

※**Remark**: n is the discrete-time index, Ω is the radial frequency, * is discrete-time convolution operator, n_d is the time lag, and $X(e^{j\Omega})$ and $Y(e^{j\Omega})$ are the discrete-time Fourier transforms of discrete-time sequences $x[n]$ and $y[n]$, respectively.

7. The following shows the block diagram of interpolator and decimator.

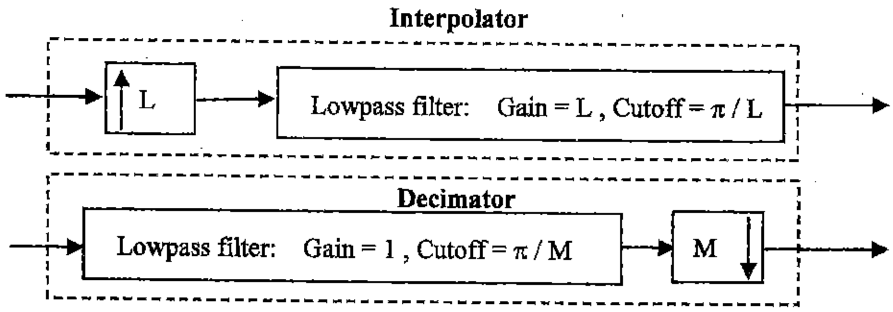

Figure 7.1

If we input a discrete-time signal $x[n] = 4\frac{\sin[(5/4)\pi n]}{\pi n}$ to the interpolator-decimator system (shown in Fig. 7.2) with L=5 and M=9, please determine the output $y[n]$. (20%)

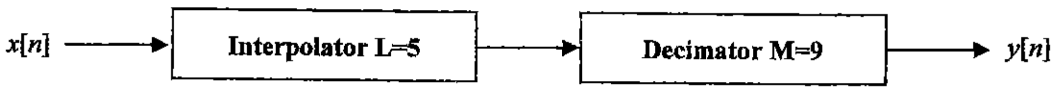

Figure 7.2