八十六學年度 電機工程 系(所) 乙 組碩士班研究生入學考試

科目 訊號與系統 科號 3103 共 3 頁第 1 頁 *請在試卷【答案卷】內作答

1. The impulse response $h_{LP}(t)$ of an ideal low-pass filter was found to be

$$h_{LP}(t)=(\omega_b/\pi)\text{sinc}\,\omega_b t$$

(a) Find the impulse response of an ideal high-pass filter. (3%)

(b) Find the impulse response of ideal band-pass filter. (3%)

(c) Find the impulse response of ideal band stop filter. (3%)

(d) Are these ideal filters stable ? (1%)

2. Find the output y(t) of the system

$$H(s)=\frac{s+3}{s^2+3s-4}$$

for each of the following inputs

(a) $x(t)=e^{-3t}u(t)$. (5%)

(b) $x(t)=\delta(t)-u(-t)$. (5%)

Please specify the region of convergence of s.

3. (a) Show that if a signal x(t) is causal and contains no impulse (or high singularity) at t=0, the initial value $x(0^+)$ is given by the following Laplace Transform limit:

$$x(0)=\lim_{s\to\infty} sX(s).$$ (4%)

(b) Determine the initial value of x(t) in each of these cases:

(1) $X(s)=\frac{1}{s+2}$ $\text{Re}\{s\}>-2$ (3%)

(2) $X(s)=\frac{s}{s^2+8}$ $\text{Re}\{s\}>0$ (3%)

4. Find the circular convolution of the two rectangular pulses

$$x_1[n] = u[n-2] - u[n-7]$$

and $$x_2[n] = u[n] - u[n-5]$$

assuming (a) N=12 (b)N=8

(10%)

5. (a) Find and sketch the impulse response h[n] for the causal LTI system satisfying

$$y[n] + y[n-1] + y[n-2] = x[n] - x[n-1]$$

(4%)

(b) Indicate whether the system is FIR or IIR.

(1%)

(c) Find and sketch the corresponding step response s[n].

(2%)

(d) Draw the corresponding direct-form-II structure.

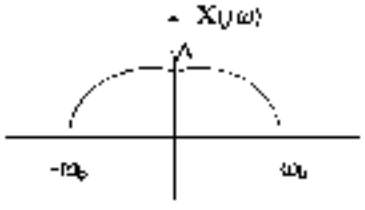
(3%)

6. Amplitude modulation can be expressed as

$$y(t) = [x(t) + B]\cos\omega_c t$$

where B is bias and ω_c is carrier frequency.

(a)Find and plot $Y(j\omega)$, if $X(j\omega)$ is as follows



(8%)

(b)For suppressed-carrier case. coherent demodulation of an AM signal can be expressed by

$$z(t) = 2y(t)\cos\omega_c t,$$

Find $Z(j\omega)$ and plot.

(7%)

7. Find the step response s[n] for each of the following systems:

(a) $H(z)=\dfrac{z^{-1}-z^{-2}}{1-2z^{-1}+2z^{-2}}$, $|z|>\sqrt{2}$ (5%)

(b) $H(z)=1-z^{-1}$, $|z|>0$ (5%)

8. Consider a system of which the relationship between the input, x(t), and output, y(t) are

$$y(t)=\int_{-\infty}^{\infty} h(t,\tau)x(\tau)d\tau .$$

Answer the following questions and give your reasons.

(a). If the system is causal, what can be said about $h(t,\tau)$? (3%)

(b). Is the system linear? (3%)

(c). Is the system time-invariant? (3%)

(d). What special properties does $h(t,\tau)$ have to acquire such that the Fourier Transform of y(t), denoted by Y(w), can be written as the product of the Fourier Transform of x(t), denoted by X(w), and another function of w denoted by K(w)? How is this K(w) related to $h(t,\tau)$? Prove it.(6%)

9. Consider the discrete-time system specified by the following difference equation:

$x(n)-\sum_{i=1}^{P} a_i x(n-i)=y(n)$, where P is an odd integer and

$a_i \in R, i=1,\ldots,P$.

a). How many poles does this system have ? What is the nonlinear equation that all the poles of the above difference equation are roots of ? (4%)

b). Will that be possible that the system does not have any real pole? Why?(3%)

c). If m_0 is a complex, but not real, pole of the system, will the complex conjugate of m_0 also be a pole of the system? Prove your answer.(3%)