國立交通大學 102 學年度碩士班考試入學試題

科目：訊號與系統(8041)　　考試日期:102 年 2 月 2 日 第 2 節

系所班別：電機學院碩士在職專班　　組別：電信組　　第 1 頁,共 1 頁

【不可使用計算機】＊作答前請先核對試題、答案卷(試卷)與准考證之所組別與考科是否相符！！

1. (30%) Consider the following 4 systems, where $x(t)$ denotes the input and $y(t)$ the output.

(i) modulation, $y(t) = x(t)\cos(100\pi t)$, (ii) convolution, $y(t) = \int_{\tau=-\infty}^{\infty} x(\tau)e^{-(t-\tau)}d\tau$,

(iii) time scaling, $y(t)=x(2t)$, (iv) averager, $y(t) = \frac{1}{2T}\int_{\tau=t-T}^{t+T} x(\tau)d\tau$.

(a) (4%) Which systems are linear?

(b) (4%) Which systems are causal?

(c) (4%) Which systems are time-invariant?

(d) (8%) For the system in (iii), suppose the input is a rectangular pulse, $x(t)=u(t)-u(t-2T)$, where $u(t)$ is a unit-step function. Find and plot the output $y(t)$ and its Fourier transform $Y(f)$.

(e) (10%) Redo (d) for the system in (iv).

2. (20%) **Write down** and **Prove** the Parseval's relation for

(a) continuous-time Fourier series expansion, and

(b) continuous-time Fourier transform,

respectively.

3. (25%) Consider the conversion of a continuous-time signal to a discrete-time sequence.

(a) (10%) Draw a block diagram to explain the sampling theorem.

(b) (15%) Suppose a continuous-time signal $x(t) = 6\cos 8\pi t$ is sampled at 10Hz. The sampling time is T=1/10 second. Denote the impulse-sampled signal as $x_s(t) = \sum_{n=-\infty}^{\infty} x(nT)\delta(t-nT)$, where $\delta(t)$ is an impulse function. Denote the discrete-time sampled sequence as $x[n] = x(t)|_{t=nT}$

Find and plot

(i) the continuous-time Fourier transform of $x(t)$,

(ii) the continuous-time Fourier transform of the sampled signal $x_s(t)$,

(iii) the discrete-time Fourier transform of the sampled sequence $x[n]$.

4. (25%) Consider a system described by $\frac{d}{dt}y(t) + ay(t) = \frac{d}{dt}x(t) + bx(t)$, where $x(t)$ denotes the input and $y(t)$ the output.

(a) (2%) Find its transfer function.

(b) (2%) Sketch its pole/zero plot.

(c) (2%) Is it causal and stable? Under what conditions?

(d) (3%) Does it have a causal and stable inverse system? If yes, find it; otherwise, explain.

(e) (3%) Find its impulse response.

(f) (3%) Find its step response.

(g) (10%) Find the output for the following inputs

(i) $x(t) = e^{-bt}\cdot u(t)$,

(ii) $x(t) = \cos 8t, -\infty < t < \infty$.