

國立清華大學 103 學年度碩士班考試入學試題

系所班組別：生醫工程與環境科學系 丙組（醫學物理與工程組）

考試科目（代碼）：生醫訊號與系統（2502）

共 1 頁，第 1 頁 *請在【答案卷】作答

1. (20 pt) Consider the Laplace transform an analog filter with the transfer function $H(s) = a/(s + a)$ and $a = 0.1$. If the filter is sampled at the sampling rate $T = 0.01s$, what is the transfer function (in terms of z-transform) of the equivalent digital filter, $H(z)$?
2. (20 pt) Consider a linear time invariant system whose impulse response is $h(t) = e^{-2t}u(t)$. Find the output when the input signal is $x(t) = [1 - \cos(2\pi t)]u(t)$.
3. (20 pt) (a) Find the frequency response function of a system whose input-output equation is $y'(t) + 10y(t) = 2x(t)$. (b) Determine the steady-state effect of this system on the input signal $x(t) = 3 \cos(6\pi t) + \sin(\pi t)$.
4. (20 pt) Consider a 1-D medical imaging system with point spread function (PSF) $h(x)$ composed of two sub-systems with Gaussian PSFs of the form $h_1(x) = \frac{1}{\sqrt{2\pi}\sigma_1} \exp\left(\frac{-x^2}{2\sigma_1^2}\right)$ and $h_2(x) = \frac{1}{\sqrt{2\pi}\sigma_2} \exp\left(\frac{-x^2}{2\sigma_2^2}\right)$. What is the PSF of this system?
5. (20 pt) The Radon transform is defined as $g(l, \theta) = \iint_{-\infty}^{\infty} f(x, y) \delta(x \cos \theta + y \sin \theta - l) dx dy$. Given a unit disk function $f(x, y) = \begin{cases} 1 & x^2 + y^2 \leq 1 \\ 0 & \text{else} \end{cases}$, what is its Radon transform at $\theta = 0$?