淡江大學九十四學年度碩士班招生考試試題 ⁸¹⁻¹

系別：電機工程學系　　　　科目：通　信　系　統

I. [20] A linear time-invariant (LTI) system has the impulse response given by $h(t) = \delta(t) + \delta'(t)$, where $\delta(t)$ is the impulse function and $\delta'(t) = d\delta(t)/dt$. Let the input to this LTI system be $x(t)$. Express the output $y(t)$ in terms of $x(t)$.

II. [20] Classify the following signals into energy-type, power-type, or neither. If the signal is energy (power)-type, find the energy (power).

    (a) $x(t) = u(t)$, where $u(t)$ is the unit step function.

    (b) $x(t) = e^{-|t|}$.

III. [20] A single sideband AM signal is generated by modulating the carrier

    $c(t) = 10\cos 2\pi \times 10^6 t$ by the information signal

    $m(t) = \cos 2000\pi t + 2\sin 4000\pi t$.

    (a) Determine the Hubert transform $\hat{m}(t)$.

Write the time-domain expression for a lower sideband AM signal.

IV. [20] A random variable X has the probability density function (PDF) given by

$$f_X(x) = \begin{cases} \dfrac{x}{\sigma^2} e^{-\frac{x^2}{2\sigma^2}}, & x \geq 0 \\ 0, & \text{elsewhere} \end{cases}$$

Show that (a) expectation $E[X] = \sigma\sqrt{\pi/2}$,

    (b) variance $V[X] = (2 - \pi/2)\sigma^2$.

V. [20] The stationary random process $X(t)$ has a power-spectral density denoted by $S_X(f)$. What is the power-spectral density of $Y(t) = X(t) - X(t - T)$?