

Yuntech EE - Signals and Systems Midterm Examination

Name: _____

ID No.: _____

95/11/14

- (20%) Please identify that the following signals are continuous-time or discrete-time. (a) Electrical currents on a printed circuit board; (b) a printed photograph; (c) the number of students each year in a university; (d) a computer image shown on the LCD display.
- (10%) Please identify that which equation is for **total energy** and the other is for **average power** of a continuous-time signal $x(t)$ over an infinite interval.

$$(a) \frac{1}{t_2 - t_1} \int_{t_1}^{t_2} |x(t)|^2 dt, \quad (b) \int_{t_1}^{t_2} |x(t)|^2 dt$$

- (15%) Please determine (**and also state the reasons**) whether (a) a discrete-time system $y[n] = x[n^2]$; (b) a continuous-time system $y(t) = \cos[2x(t)]$; and (c) a continuous-time system $y(t) = x(t - 2)$ is **time-invariant** or not.
- (20%) Let $x(t) = u(t) - u(t - 5)$ and $h(t) = e^{-2t}u(t)$. Please calculate (a) $y(t) = x(t) * h(t)$ and (b) $g(t) = \frac{dx(t)}{dt} * h(t)$.
- (20%) Please draw the block diagrams of two difference equations: (a) $y[n] = ay[n - 1] - bx[n]$; (b) $y(t) = \int_{-\infty}^t [bx(\tau) + ay(\tau)]d\tau$
- (10%) Determine (**and also state the reasons**) whether or not each of the following continuous-time and discrete-time signals is periodic. If the signal is periodic, determine its fundamental period. (a) $x(t) = \sin(2t - \frac{\pi}{3})$; (b) $x[n] = \cos(\frac{n}{6} - \pi)$.

- (15%) For the continuous-time periodic signal $x(t) = 5 + 6 \sin(\frac{2\pi}{3}t) + 7 \cos(\frac{4\pi}{3}t)$, determine the fundamental frequency w_0 and the Fourier series coefficients a_k such that

$$x(t) = \sum_{k=-\infty}^{\infty} a_k e^{jkw_0t}.$$

- (10%) For an input $x[n] = z^n$, we can determine the output through the use of the convolution sum, i.e.,

$$y[n] = \sum_{k=-\infty}^{\infty} h[k]x[n - k] = z^n H[z].$$

Please show that

$$H[z] = \sum_{k=-\infty}^{\infty} h[k]z^{-k}.$$