Signals and Systems HW4
Deadline: 2019/04/08 before 18:30
(You should submit hand-writing paper to BL B1 EE student office.)

1. (30%)Suppose a continuous-time signal $x(t)$ is an odd signal. Show that the Fourier transform $X(j\omega)$ of $x(t)$ is given by

$$X(j\omega) = -2j\int_0^{\infty} x(t)\sin(\omega t)\,dt$$

2. The output $y(t)$ of a causal LTI system is related to the input $x(t)$ by the equation

$$\frac{dy(t)}{dt} + 10y(t) = \int_{-\infty}^{\infty} x(\tau)z(t-\tau)d\tau - x(t)$$

where $z(t) = e^{-t}u(t) + 3\delta(t)$

(a) (20%) Find the frequency response $H(j\omega)$ of this system.

($H(j\omega) = \frac{Y(j\omega)}{X(j\omega)}$, where $X(j\omega)$ and $Y(j\omega)$ are the Fourier transform of $x(t)$ and $y(t)$ respectively.)

(b) (20%) Determine the impulse response $h(t)$ of the system in time domain.

3. Use the Parseval's relation to obtain the value of the integral

$$\int_{-\infty}^{\infty} [\mathrm{sinc}(\alpha t)]^2\,dt$$

where $\mathrm{sinc}(t) = \frac{\sin(\pi t)}{\pi t}$,

as an explicit function of α. (30%)