Signals and Systems

Examination Paper A for Students of Grade 2018

Class_____Student Number_____Name_____

Problem	1	2	3	4	5	6	7	8	9	Total Scores
Scores	10	12	10	12	10	8	12	10	16	100
Get Scores										

1. (10 scores) The signal $x(t)$ is shown in Fig.1, please sketch the waveform $y(t) = x(-2t + 6)$.
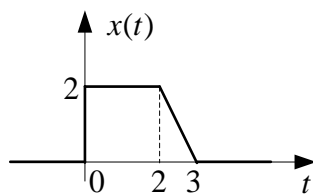

Fig.1

2. (12 scores) A system is described by $y(t) = \cos\left(3t - \dfrac{\pi}{2}\right)x(t)$,please judge the properties of the system and give your reasons.

(1) memory?; (2) linear?; (4) time-invariant?; (3) causal?

3. (10 scores)The differential equation of a system is

$$\frac{d^2 y(t)}{dt^2} + 5\frac{dy(t)}{dt} + 6y(t) = x(t)$$

Please calculate:

（1）the impulse response $h(t)$;

（2）if $x(t) = e^{-t}u(t)$,calculate the zero-state response $y(t)$.

4. (12 scores) Please calculate the following convolutions:

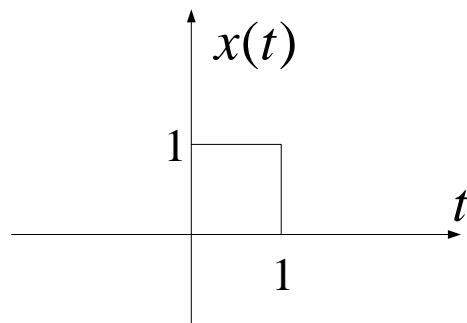(1) $x(t)$ and $h(t)$ are shown in Fig.2.a and Fig.2.b, please calculate $y(t)=x(t)*h(t)$.
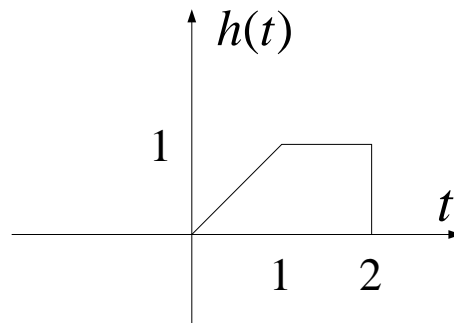

Fig.2.a   Fig.2.b

（2） $x[n] = \delta[n+1] + 2\delta[n] + \delta[n-1]$, $v[n] = \delta[n-1] + 2\delta[n-2]$,

$y[n] = x[n] * v[n] = ?$ (convolution sum)

（3） $x[n] = 2\delta[n] + \delta[n-1] - \delta[n-2] + 3\delta[n-3]$, $v[n] = \delta[n] + 2\delta[n-1]$

$y[n] = x[n] \textcircled{4} v[n] = ?$ or expressed as $y[n] = x[n] \circledast v[n] = ?$

N=4,4-point circular convolution

5. (10 scores) A periodic signal is shown in Fig.3, Please calculate:

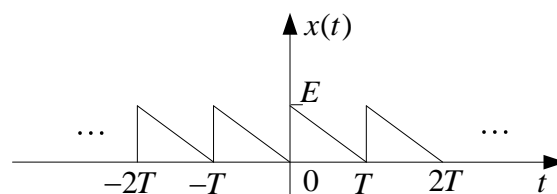(1) trigonometric Fourier series;

(2) exponential Fourier series.

Fig.3

6. (8 scores) A continuous-time signal $x(t)$ has Fourier transform $X(\omega)$. Please calculate the Fourier transforms for the following signals:

（1） $f_1(t) = tx(2t)$

（2） $f_2(t) = (1-t)x(1-t)$

7. (12 scores) A circuit is shown in Fig.4. Assuming that the circuit is in steady state at $t < 0$, and the switch is opened at $t = 0$, Please calculate the current $i(t)$, $t \geq 0$.
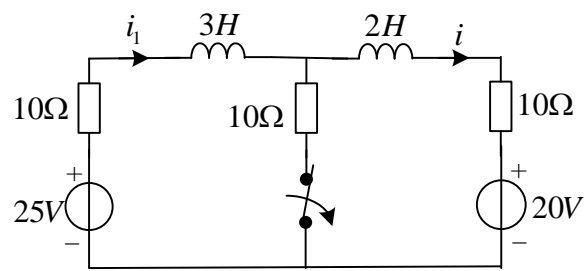

Fig.4

8. (10 scores) A continuous time signal is $x(t) = \cos(2\pi ft)$, if $f = 1\,\text{Hz}$, the sampling

interval $T_S = \dfrac{1}{4}$ seconds, the sampled signal is $x[n]$, please calculate:

(1) the discrete values of the 4 points;

(2) four-point DFT of $x[n]$;

(3) four-point DTFT of $x[n]$.

9. (16 scores) A causal linear time invariant system is described by following difference equation

$$y[n] - \frac{3}{4} y[n-1] + \frac{1}{8} y[n-2] = x[n]$$

(1) calculate the transfer function (or system function) $H(z)$;

(2) calculate the unit pulse response $h[n]$;

(3) calculate the unit step response $y[n]$;

(4) judge the stability of the system, and give your reason.