UNIVERSITI MALAYSIA PERLIS

Peperiksaan Pertengahan Semester I
Sesi Akademik 2020/2021

DKT 215 – Signals and Systems Principles
[Prinsip Isyarat dan Sistem]

Masa: 1 Jam 30 Minit

Answer **ALL** questions.

Question 1

a) Find the Fourier transforms of the following signals:

i. $x(t) = 1$

ii. $x(t) = e^{j\omega_0 t}$

iii. $x(t) = e^{-j\omega_0 t}$

iv. $x(t) = \cos \omega_0 t$

v. $x(t) = \sin \omega_0 t$

(5 Marks)

b) Consider a continuous-time LTI system described by $\frac{dy(t)}{dt} + 2y(t) = x(t)$. Using the Fourier transform, find the output $y(t)$ when $x(t) = e^{-t}u(t)$.

(5 Marks)

Question 2

a) Consider the system described by

$$y^{'}(t) + 2y(t) = x(t) + x^{'}(t)$$

Use Fourier transform to evaluate the impulse response of the system.

(4 Marks)

b) A stable and causal LTI system is given by the differential equation

$$\frac{d^2y(t)}{dt^2} + 6\frac{dy(t)}{dt} + 8y(t) = 2x(t)$$

Evaluate the frequency and impulse responses of this system.

(6 Marks)

Question 3

a) A causal discrete-time LTI system is described by

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

where $x[n]$ and $y[n]$ are the input and output of the system, respectively.

i. Determine the frequency response $H(\Omega)$ of the system.

(3 Marks)

ii. Find the impulse response $h[n]$ of the system.

(3 Marks)

b) The LTI system is given by $y[n] - \frac{3}{4}y[n-1] + \frac{1}{8}y[n-2] = 2x[n]$ and let the input to this system be $x[n] = \left(\frac{1}{4}\right)^n u[n]$. Find the inverse Fourier transform.

(4 Marks)

$x(t)$	$X(\omega)$
$\delta(t)$	1
1	$2\pi\delta(\omega)$
$\delta(t-t_0)$	$e^{-j\omega t_0}$
$e^{j2\pi f_0 t}$	$2\pi\delta(\omega-\omega_0)$
$\cos(2\pi f_0 t)$	$\pi\left[\delta(\omega-\omega_0)+\delta(\omega+\omega_0)\right]$
$\sin(2\pi f_0 t)$	$-j\pi\left[\delta(\omega-\omega_0)-\delta(\omega+\omega_0)\right]$
$rect(t)$	$\mathrm{sinc}\left(\frac{\omega}{2\pi}\right)$
$\mathrm{sinc}(t)$	$rect\left(\frac{\omega}{2\pi}\right)$
$\Lambda(t)$	$\mathrm{sinc}^2\left(\frac{\omega}{2\pi}\right)$
$\mathrm{sinc}^2(t)$	$\Lambda\left(\frac{\omega}{2\pi}\right)$
$e^{-\alpha t}u(t), \quad \alpha>0$	$\frac{1}{\alpha+j\omega}$
$te^{-\alpha t}u(t), \quad \alpha>0$	$\frac{1}{(\alpha+j\omega)^2}$
$e^{-\alpha\|t\|}, \quad \alpha>0$	$\frac{2\alpha}{(\alpha^2+(\omega)^2}$
$e^{-\pi t^2}$	$e^{-\alpha f^2}$
$\mathrm{sgn}(t)$	$\frac{2}{j\omega}$
$u(t)$	$\pi\delta(\omega)+\frac{1}{j\omega}$
$\frac{d}{dt}\delta(t)$	$j\omega$
$\sum_{n=-\infty}^{\infty}\delta(t-nT_0)$	$\frac{1}{T_0}\sum_{n=-\infty}^{\infty}\delta\left(\omega-\frac{2\pi n}{T_0}\right)$

$x[n]$	$X(\Omega)$
$\delta[n]$	1
$\delta[n-n_0]$	$e^{-j\Omega n_0}$
$x[n]=1$	$2\pi\delta(\Omega), \lvert\Omega\rvert \le \pi$
$e^{j\Omega_0 n}$	$2\pi\delta(\Omega-\Omega_0), \lvert\Omega\rvert, \lvert\Omega_0\rvert \le \pi$
$\cos \Omega_0 n$	$\pi[\delta(\Omega-\Omega_0)+\delta(\Omega+\Omega_0)], \lvert\Omega\rvert, \lvert\Omega_0\rvert \le \pi$
$\sin \Omega_0 n$	$-j\pi[\delta(\Omega-\Omega_0)-\delta(\Omega+\Omega_0)], \lvert\Omega\rvert, \lvert\Omega_0\rvert \le \pi$
$u[n]$	$\pi\delta(\Omega)+\dfrac{1}{1-e^{-j\Omega}}, \lvert\Omega\rvert \le \pi$
$-u[-n-1]$	$-\pi\delta(\Omega)+\dfrac{1}{1-e^{-j\Omega}}, \lvert\Omega\rvert \le \pi$
$a^n u[n], \lvert a\rvert < 1$	$\dfrac{1}{1-ae^{-j\Omega}}$
$-a^n u[-n-1], \lvert a\rvert > 1$	$\dfrac{1}{1-ae^{-j\Omega}}$
$(n+1)a^n u[n], \lvert a\rvert < 1$	$\dfrac{1}{\left(1-ae^{-j\Omega}\right)^2}$
$a^{\lvert n\rvert}, \lvert a\rvert < 1$	$\dfrac{1-a^2}{1-2a\cos\Omega+a^2}$
$x[n]=\begin{cases}1 & \lvert n\rvert \le N_1 \\ 0 & \lvert n\rvert > N_1\end{cases}$	$\dfrac{\sin\left[\Omega\left(N_1+\frac{1}{2}\right)\right]}{\sin(\Omega/2)}$
$\dfrac{\sin Wn}{\pi n}, 0 < W < \pi$	$X(\Omega)=\begin{cases}1 & 0 \le \lvert\Omega\rvert \le W \\ 0 & W < \lvert\Omega\rvert \le \pi\end{cases}$
$\sum_{k=-\infty}^{\infty} \delta[n-kN_0]$	$\Omega_0 \sum_{k=-\infty}^{\infty} \delta(\Omega-k\Omega_0), \Omega_0=\dfrac{2\pi}{N_0}$