UNIVERSITI SAINS MALAYSIA

Peperiksaan Semester Kedua
Sidang Akademik 2005/2006
Second Semester Examination
2005/2006 Academic Session

April/Mei 2006
April/Mei 2006

ESA 254/3 – Isyarat dan Sistem Elektronik Berdigit

Signal and Electronics Digital System

Masa : 3 jam
Duration : 3 hours

ARAHAN KEPADA CALON :
INSTRUCTION TO CANDIDATES

Sila pastikan bahawa kertas peperiksaan ini mengandungi **TIGA BELAS (13)** mukasurat dan **LAPAN (8)** soalan sebelum anda memulakan peperiksaan ini.
*Please ensure that this paper contains **THIRDTEEN (13)** printed pages and **EIGHT (8)** questions before you begin examination.*

Jawab **LIMA** soalan. Rujuk kepada Jadual 1 dan 2 bagi **'Fourier Series and Fourier Transforms'.**
*Answer **FIVE** questions only. Refer to Table 1 and 2 for **'Fourier Series and Fourier Transforms'.***

Pelajar-pelajar dikehendaki menjawab soalan 1,2,3,4,5 dalam Bahasa Inggeris dan soalan 6,7,8 dalam Bahasa Malaysia.
Student should answer questions 1, 2, 3, 4, 5 in English and questions 6, 7, 8 in Bahasa Malaysia

Setiap soalan mestilah dimulakan pada mukasurat yang baru.
Each questions must begin from a new page.

1. (a) Berikan klasifikasi isyarat dan sistem berserta contoh untuk setiap jenis isyarat dan sistem.

Give the classification of signals and systems with example for each type of signal and system.

(5 markah/*marks*)

(b) Cari komponen-komponen genap dan ganjil dalam persamaan berikut :

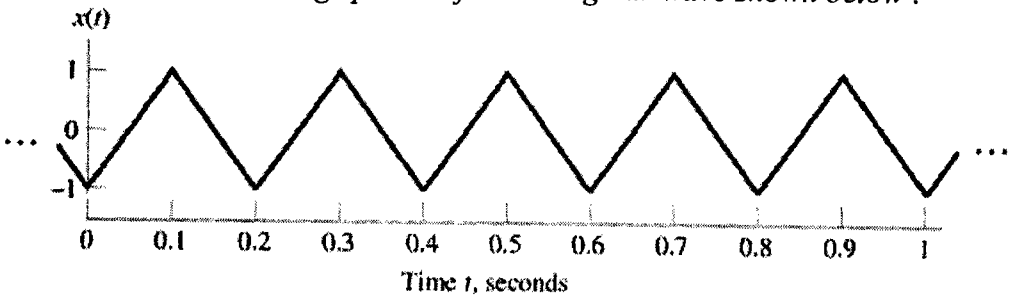
Find the even and odd components of the following :

$$x(t) = t\cos(t) + t^3\sin(t) + t^4\sin(t)\cos(t) + \cos^3(t)$$

(5 markah/*marks*)

(c) Dapatkan purata kuasa untuk gelombang setiga berikut :

Determine average power of the triangular wave shown below :



(5 markah/*marks*)

(d) Tentukan samada sistem yang diberikan ialah:

(i) penyebab
(ii) linear
(iii) tanpa memori
(iv) stabil
(v) masa tak berubah

Find whether the given system is

(i) causal
(ii) linear
(iii) memoryless
(iv) stable
(v) time invariant

$$Y[n] = \left[\frac{n+3}{n+2.5}\right]x[n] + x[n-1]$$

(5 markah/*marks*)

2. (a) Takrifkan dan lakarkan bentuk gelombang (i) *delta function* dan (ii) *unit step function*, berikan hubungan antara *unit step function* dan *delta function* dalam kedua-dua *continuous* dan *discrete domain.*

Define and draw the wave forms of (i)delta function and (ii)unit step function, give the relation between unit step function and delta functions both in continuous and discrete domains.

(6 markah/*marks*)

(b) Dapatkan lingkaran yang diberikan oleh fungsi persamaan masa *continuous* dibawah.

Find the convolution of the given continuous time functions

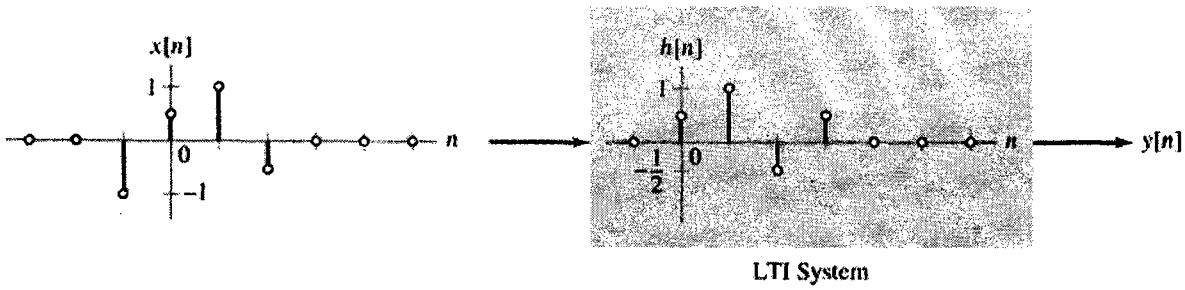
$$x(t) = \begin{cases} 1, for 0 \le t \le T \\ 0, otherwise \end{cases}$$

$$h(t) = \begin{cases} t, for 0 \le t \le 2T \\ 0, otherwise \end{cases}$$

(7 markah/*marks*)

(c) Cari lingkaran yang diberkan dalam gambarajah fungsi persamaan *discrete*

Find the convolution of the given discrete time functions



(a)

(7 markah/*marks*)

3. (a) Berikan persamaan untuk contoh persamaan siri fourier bagi persamaan *continuous* isyarat berjangkamasa x(t)

Carikan perwakilan siri Fourier untuk x(t) yang diberi

Give the expression for Fourier series representation of continuous time periodic signal x(t)

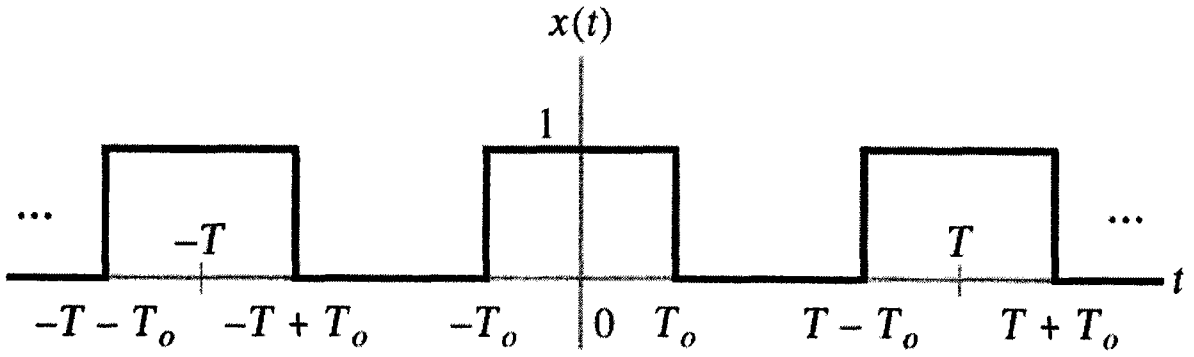
Find the Fourier series representation of the given x(t)

$$x(t) = 20 + 3\cos w_0 t + 6\cos(2w_0 t + 45^0) + 4\sin 3w_0 t + \cos(4w_0 t)$$

(6 markah/*marks*)

(b) Berikan persamaan bersiri fourier untuk x(t)

Find the Fourier series coefficients of the time domain function x(t)



(6 markah/*marks*)

(c) Cari *Fourier Transform* bagi fungsi masa x(t) yang diberikan dan lakarkan juga nilai magnitud dan reaksi fasa

Find the Fourier transform of the given time domain function x(t) and also plot its magnitude and phase response.

$$x(t) = \begin{cases} 1, for -T_0 \le t \le T_0 \\ 0, otherwise \end{cases}$$

(8 markah/*marks*)

4. (a) Dengan mengunakan perbezaan kandungan dari perubahan Fourier. Nyatakan dan buktikan bahawa lingkaran domain masa ialah bersamaan dengan hasil domain frekuensi

What are the different properties of Fourier transforms. State and prove convolution in time domain is equivalent to product in frequency domain.

(8 markah/*marks*)

(b) Dengan menggunakan kepelbagaian kandungan, cari *fourier transform* untuk persamaan berikut

Using multiple properties find the Fourier transform of the following

$$x(t) = \sin(2\pi t)e^{-t}u(t)$$

(6 markah/*marks*)

(c) Apakah berbezaan antara mikropemperosesan dan mikropengawal. Lukiskan gambarajah blok dan terangkan fungsi setiap blok dalam mikropengawal 8051

What are the differences between micro- processor and micro- controller. Draw the block diagram and explain the function of each block of the 8051 micro controller.

(6 markah/*marks*)

5. (a) Tuliskan program *assembly language* untuk penambahan dua nombor hexa desimal 88H dan 93H. Tunjukkan hasil jawapan di lokasi ingatan 2300H. Tunjukkan status CY, AC dan bendera P.

Write an assembly language program for addition of two hexa decimal numbers 88 H and 93 H. Show the result in memory location 2300 H. Show the status of the CY, AC and P flags.

(8 markah/*marks*)

(b) Tuliskan program *assembly language* untuk campuran nilai 79H, F5 H dan E2 H. Masukkan nilai camputan dalam register R0 (lower byte) dan R5 (higher byte)

Write an assembly language program to find the sum of the values 79 H, F5 H, and E2 H. Put the sum in registers R0 (lower byte) and R5(higher byte).

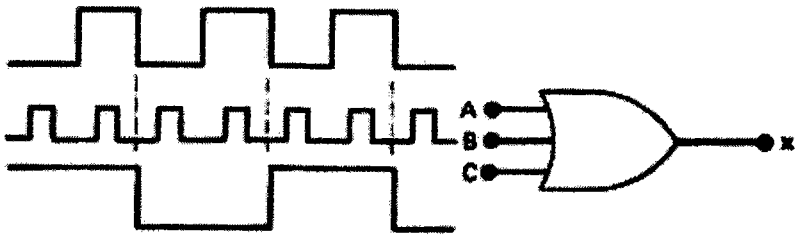
(8 markah/*marks*)

(c) Berapa banyak bitkah di dalam *program status word register.* Apakah informasi yangboleh didapati dati setiap bit di dalam *program status word register.*

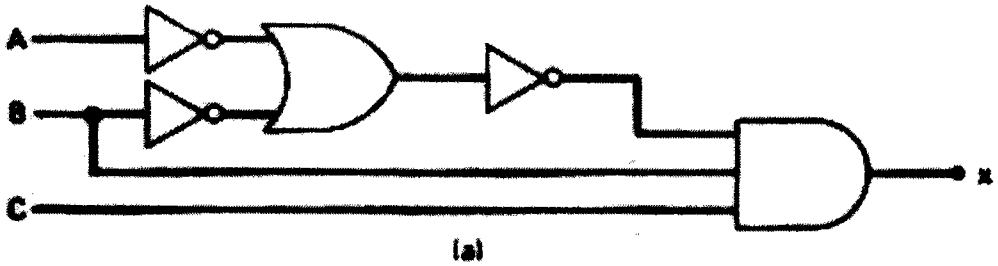
How many bits are there in program status word register. What is the information you get from each bit of the program status word register.

(4 markah/*marks*)

6.

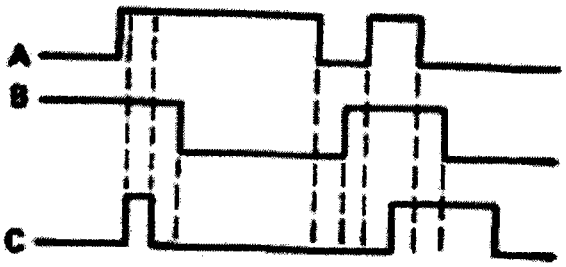


Gambarajah 1.1
Figure 1.1



(a)

Gambarajah 1.2
Figure 1.2



Gambarajah 1.3
Figure 1.3

(a) Dengan berpandukan gambarajah 1.1,

i. Gunakan gambarajah tempoh untuk melakarkan keluaran isyarat untuk litar gambarajah 1.1.
ii. Jika masukan A di gambarajah 1.1 disambungkan ke bumi, lakarkan hasil keluaran isyarat.
iii. Jika masukan A di gambarajah 1.1 disambungkan dengan sumber +5V, lakarkan hasil keluaran isyarat

Refering to Figure 1.1

i. Using timing diagram, Draw the output waveform for the circuit in Figure 1.1.
ii. Suppose the A input in Figure 1.1 is unintentionally shorted to the ground, Draw the resulting output waveform.
iii. Suppose that the A input in Figure 1.1 is unintentionally shorted to +5V supply. Draw the resulting output waveform.

(b) Tuliskan ungkapan Boolean untuk keluaran x bagi gambarajah 1.2. Dapatkan keluaran x bagi nilai masukan yang sesuai dan senaraikan kesemua nilai di jadual kebenaran.

Write a Boolean expression for the output x in Figure 1.2. Determine the value of x for all possible input condition and list the values in a truth table.

(c) Bina litar logic dengan menggunakan get AND, OR dan INVERTER dengan menggunakan ungkapan dibawah:

i. $z = \left(\overline{A + B + \overline{C}D\overline{E}}\right) + \overline{B}C\overline{D}$

ii. $z = MN(P + \overline{N})$

For the following expressions, construct the corresponding logic circuit using AND, OR and INVERTER gates.

a. $z = \left(\overline{A + B + \overline{C}D\overline{E}}\right) + \overline{B}C\overline{D}$

b. $z = MN(P + \overline{N})$

(d) Berpandukan gambarajah 1.3, gunakan isyarat gambarajah 1.3 bagi get NOR and lakarkan isyarat keluaran.

Refer to Figure 1.3, apply the waveform of Figure 1.3 to a NOR gate and draw the output waveform.

(markah/*marks*)

7. (a) Apakah yang dimaksudkan dengan singkatan nama TTL dan CMOS? Apakah perbezaan utama proses tersebut.

What is TTL and CMOS abbreviation stands for? What are their major differences.

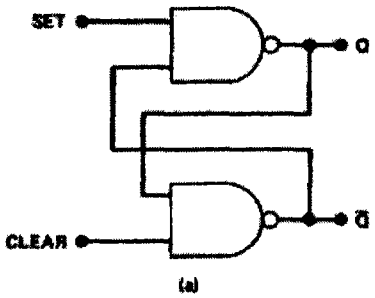
(b) Senaraikan DUA (2) kerosakan luaran yang biasa dan berikan contoh-contoh untuk setiap kerosakan tersebut.

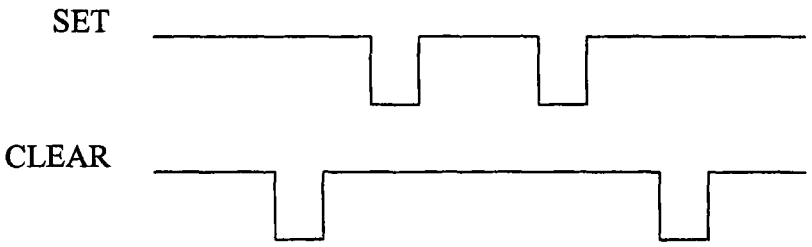
List out TWO (2) the most common types of external faults and give some examples to each common faults.

(c) Terdapat empat tangki besar yang mempunyai cecair yang sedang dipanaskan di sebuah tapak pemerosesan kimia. Alat pengesan aras cecair digunakan untuk mengesan samada tahap tangki A atau tangki B meningkat pada kadar yang ditetapkan. Pengesan haba di tangki C dan D mengesan apabila haba pada mana-mana tangki jatuh di bawah paras yang ditetapkan. Andaikan bahawa pengesan aras cecair keluaran A dan B adalah RENDAH bila aras yang memuaskan dan TINGGI apabila aras meningkat tinggi. Dan juga, haba pengesan keluaran C dan D adalah RENDAH bila haba ditahap memuaskan dan TINGGI apabila haba menjunam rendah. Reka sebuah litar logik yang dapat mengesan aras tangki A atau B adalah tinggi dan pada masa yang sama, aras haba untuk tangki C atau D adalah rendah.

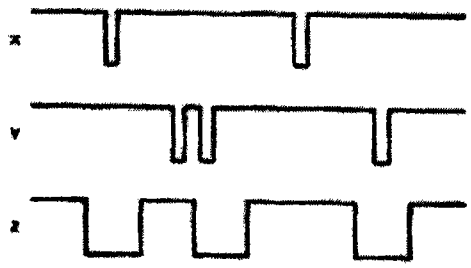
Four large tanks at a chemical processing plant contain different liquids being heated. Liquid-level sensors are being used to detect whenever the level in tank A or tank B rises above a predetermined level. Temperature sensors in tanks C and D detect when the temperature in either of these tanks drops below a prescribed temperature limit. Assume that the liquid level sensor outputs A and B are LOW when the level is satisfactory and HIGH when the level is too high. Also, the temperature sensor outputs C and D are LOW when the temperature is satisfactory and HIGH when the temperature is too low. Design a logic circuit that will detect whenever the level in tank A or tank B is too high at the same time that the temperature in either tank C or tank D is too low.

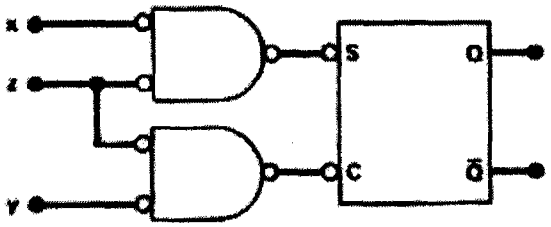
8.



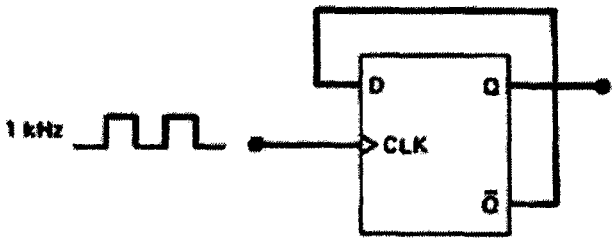


Gambarajah 3.1(a) –(b)
Figure 3.1(a) –(b)





Gambarajah 3.2(a)-(b)
Figure 3.2(a)-(b)



Gambarajah 3.3
Figure 3.3

(a) Dengan berpandukan gambarajah 3.1

i. Terangkan secara ringkas proses NAND Latch dam tunjukkan jadual kebenaran.

ii. Isyarat gambarajah 3.1(b) dimasukkan ke dalam get NAND latch dalam gambarajah 3.1(a). Andaikan keluaran pada mulanya ialah Q_o=0, dapatkan isyarat keluaran Q untuk seterusnya

Refer to Figure 3.1

i. Summarize the process of NAND Latch and show the truth table,

ii. The waveform input shown in Figure 3.1(b) is applied to the inputs of a NAND gate latch in Figure 3.1(a). Assume that initially Q = 0, and determine the Q waveform:

(b) Lakarkan SC flip-flop and tunjukkan jadual kebenaran.

Draw the SC Flip-flop and show the truth table.

(c) Isyarat gambarajah 3.2(a) dimasukkan ke dalam litar di gambarajah 3.2(b). Andaikan bahawa Q_o=0 pada mulanya, dapatkan isyarat keluaran Q.

The waveform in Figure 3.2(a) are connected to the circuit of Figure 3.2(b). Assume that Q = 0 initially, and determine the Q waveform.

(d) Lakarkan rekabentuk D flip-flop dengan menggunakan JK flip-flop.

Sketch D flip-flop using JK flip-flop.

(e) Sebuah D flip flop pacuan sisi dapat dihasilkan dengan operasi mod tukaran berpandukan gambarajah 3.3. Andaikan Q_o = 0 pada mulanya, dapatkan hasil keluaran isyarat Q.

An edge triggered D flip-flop can be made to operate in the toggle mode by connecting it as show in Figure 3.3. Assume that Q_o = 0 initially and determine the Q waveform.

Table 1

Property	Aperiodic Signal	Fourier transform
	$x(t)$ $y(t)$	$X(j\omega)$ $Y(j\omega)$
Linearity	$Ax(t)+By(t)$	$AX(j\omega)+BY(j\omega)$
Time shifting	$x(t-t_0)$	$X(j\omega)e^{-j\omega t_0}$
Frequency shifting	$e^{j\omega_0 t}x(t)$	$X(j(\omega-\omega_0))$
Conjugation	$x^*(t)$	$X^*(-j\omega)$
Time reversal	$x(-t)$	$X(-j\omega)$
Time and frequency scaling	$x(at)$	$\frac{1}{\lvert a\rvert}X(\frac{j\omega}{a})$
Convolution	$x(t)*y(t)$	$X(j\omega)Y(j\omega)$
Multiplication	$x(t)y(t)$	$\frac{1}{2\pi}\int_{-\infty}^{+\infty}X(j\theta)Y(j(\omega-\theta))d\theta$
Differentiation in time	$\frac{dx(t)}{dt}$	$j\omega X(j\omega)$
Integration	$\int_{-\infty}^{t}x(t)dt$	$\frac{1}{j\omega}X(j\omega)+\pi X(0)\delta(\omega)$
Differentiation in frequency	$tx(t)$	$j\frac{d}{d\omega}X(j\omega)$
Conjugate symmetry For real signals	$x(t)$ real	$\begin{cases}X(j\omega)=X^*(-j\omega)\\ \mathrm{Re}\{X(j\omega)\}=\mathrm{Re}\{X(-j\omega)\}\\ \mathrm{Im}\{X(j\omega)\}=-\mathrm{Im}\{X(-j\omega)\}\\ \lvert X(j\omega)\rvert=\lvert X(-j\omega)\rvert\\ \angle X(j\omega)=-\angle X(-j\omega)\end{cases}$
Real and even signals	$x(t)$ real and even	$X(j\omega)$ real and even
Real and odd signals	$x(t)$ real and odd	$X(j\omega)$ purely imaginary and odd
Even-odd decomposition of real signals	$\begin{cases}x_e(t) & \mathrm{Even}\{x(t)\}\,[x(t)\text{ real}]\\ x_o(t) & \mathrm{Odd}\{x(t)\}\,[x(t)\text{ real}]\end{cases}$	$\mathrm{Re}\{X(j\omega)\}$ $j\,\mathrm{Im}\{X(j\omega)\}$
Parseval's relation for aperiodic signals $\int_{-\infty}^{+\infty}\lvert x(t)\rvert^2dt=\frac{1}{2\pi}\int_{-\infty}^{+\infty}\lvert X(j\omega)\rvert^2d\omega$		

Table 2

Signal	Fourier transform	Fourier Series coefficients (if periodic)
$\sum_{k=-\infty}^{k=+\infty} c_k e^{jk\omega_0 t}$	$2\pi \sum_{k=-\infty}^{k=+\infty} c_k \delta(\omega - k\omega_0)$	c_k
$e^{j\omega_0 t}$	$2\pi\delta(\omega-\omega_0)$	$c_1 = 1$ $c_k = 0$, otherwise
$\cos\omega_0 t$	$\pi[\delta(\omega-\omega_0)+\delta(\omega+\omega_0)]$	$c_1 = c_{-1} = \frac{1}{2}$ $c_k = 0$, otherwise
$\sin\omega_0 t$	$\frac{\pi}{j}[\delta(\omega-\omega_0)-\delta(\omega+\omega_0)]$	$c_1 = -c_{-1} = \frac{1}{2j}$ $c_k = 0$, otherwise
$x(t) = 1$	$2\pi\delta(\omega)$	$c_0 = 1, c_k = 0, k \neq 0$ (This is the Fourier series representation for any choice of $T > 0$)
Periodic square wave $x(t) = \begin{cases} 1, & \lvert t\rvert < T_1 \\ 0, & T_1 < \lvert t\rvert \le \frac{T}{2} \end{cases}$ and $x(t+T) = x(t)$	$\sum_{k=-\infty}^{k=+\infty} \frac{2\sin k\omega_0 T_1}{k} \delta(\omega - k\omega_0)$	$\frac{\omega_0 T_1}{\pi}\text{sinc}(\frac{k\omega_0 T_1}{\pi}) = \frac{\sin k\omega_0 T_1}{k\pi}$
$\sum_{n=-\infty}^{n=+\infty} \delta(t-nT)$	$\frac{2\pi}{T}\sum_{k=-\infty}^{k=+\infty} \delta(\omega - \frac{2\pi k}{T})$	$c_k = \frac{1}{T}$ for all k
Rectangular pulse $x(t) = \begin{cases} 1, & \lvert t\rvert < T_1 \\ 0, & \lvert t\rvert > T_1 \end{cases}$	$\frac{2\sin\omega T_1}{\omega}$	
$\frac{\sin Wt}{\pi t}$	$X(j\omega) = \begin{cases} 1, & \lvert\omega\rvert < W \\ 0, & \lvert\omega\rvert > W \end{cases}$	
$\delta(t)$	1	
$u(t)$	$\frac{1}{j\omega} + \pi\delta(\omega)$	
$\delta(t-t_0)$	$e^{-j\omega t_0}$	
$e^{-at}u(t), \text{Re}\{a\} > 0$	$\frac{1}{a+j\omega}$	
$te^{-at}u(t), \text{Re}\{a\} > 0$	$\frac{1}{(a+j\omega)^2}$	
$\frac{t^{n-1}}{(n-1)!}e^{-at}u(t), \text{Re}\{a\} > 0$	$\frac{1}{(a+j\omega)^n}$	

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