Signals and Systems - 信号与系统 - 补充资料- SZU1102150001

- 补充资料将分发给考试学生。内容: (1) 中英词汇; (2) 重要公式列表; (3) 参考列表。
- 学生可以带字典进入考场

(1) 中英词汇

introduction

English	Chinese
signals and systems	信号和系统
continuous time signal	连续时间信号
discrete time signal	离散时间信号
sampled discrete time signal	采样离散时间信号
real and complex signals	真实信号和复杂信号
deterministic signal	确定性信号
random signal	随机信号
even signal	均匀信号
odd signal	奇数信号
periodic signal	周期性信号
non-periodic signal	非周期性信号
energy and power	能源和电力
physical quantity	物理量
variable	变量
phenomenon	现象
RC circuit	RC 电路
capacitor	电容器
samples	样品
sampling interval	采样间隔
sequence	序列
real and complex number	实数和复数
analogue signal	模拟信号
digital signal	数字信号
fundamental period	基本周期
instantaneous power	瞬时功率
average power	平均功率
normalized energy	归一化能量
normalized average power	归一化平均功率

Signal types and systems classification

English	Chinese
Unit Step Function	单位步进函数

Heaviside Unit Function	Heaviside 单元功能
Unit Impulse Function	单位脉冲函数
Dirac Delta Function	狄拉克 Delta 函数
Time Shifted	时移
Exponential Function	指数函数
Euler's Formula	欧拉公式
Real Signal	真实信号
Complex Signal	复杂信号
Periodic Signal	周期性信号
Fundamental Period	基本面
Fundamental Frequency	基频
Real Part and Imaginary Part	实部和虚部
Radian	弧度
Discrete Time Signal	离散时间信号
Continuous Time Signal	连续时间信号
Unit Step Sequence	单位步长序列
Unit Impulse Sequence	单位脉冲序列
Sinusoidal Sequence	正弦序列
Operator	算子
Deterministic System	确定性系统
Stochastic System	随机系统
Nonlinear System	非线性系统
Time Invariant System	时间不变系统
Time Varying System	时变系统
Bounded Input	有界输入
Bounded Output	有界输出

LTI systems 1

English	**Chinese**
Linear Time Invariant System	线性时不变系统
Convolution Sum	卷积和
Superposition Sum	叠加总和
Convolution Integral	卷积积分
Discrete time	离散时间
Continuous Time	连续时间
Superposition Property	叠加属性
Time Shifted	时移
Scaled Unit	缩放单位
Impulse Sequence	脉冲序列
Unit Impulse Response	单元脉冲响应
Geometric Sum Formula	几何求和公式
Analogue Signals	模拟信号
Staircase Waveform	楼梯波形

LTI systems 2

English	Chinese
Linear Time Invariant Systems	线性时间不变系统
Eigenfunction and Eigenvalue	特征函数和特征值
Commutative Property	交换特性
Distributive Property	分配律
Associative Property	关联属性
Unit Impulse	单位脉冲
Invertibility	可逆
Inverse System	逆系统
Causal and Non-Causal System	因果和非因果系统
Discrete Fourier Transform	离散傅里叶变换

Laplace Transform 1

English	Chinese
Laplace transform	拉普拉斯变换
s domain	S 域
complex variable	复变量
continuous time LTI system	连续时间 LTI 系统
unilateral and bilateral	单边和双边
region of convergence	收敛区域
s-plane	S-平面
complex plane	复平面
poles and zeros	极点和零点
numerator and denominator	分子和分母
set notation	设置符号。

Laplace transform 2

English	Chinese
Inverse Laplace transform	逆拉普拉斯变换
System Function	系统功能
Unilateral Laplace transform	单边拉普拉斯变换
Partial Fraction Expansion	部分馏分展开
Cascade	级联
Transform Circuits	变换电路

Fourier Series

English	Chinese
Fourier series	傅里叶级数
convergence	收敛

harmonics	谐波
sinusoidal signal	正弦信号
fundamental frequency	基频
Euler's rule	欧拉法则
magnitude and phase	幅度和相位
Dirichlet conditions	狄利克雷条件
exponential Fourier series	复指数傅里叶级数
trigonometric Fourier series	三角傅里叶级数
harmonic form Fourier series	谐波形式傅里叶级数

Fourier Transform

English	Chinese
Fourier Transform	傅里叶变换
continuous time	连续时间
filtering	滤波
fundamental period	基本时期
Complex Fourier Coefficients	复傅里叶系数
infinitesimal	渺小
nonperiodic	非周期性
Fourier spectra	傅里叶光谱
Fourier Transform Pair	傅里叶变换对
Convergence	收敛
Duality	二重性
Parseval's Theorem	帕斯瓦尔定理
Frequency response	频率响应
amplitude distortion	幅度失真
phase distortion	相位失真
Low pass filter	低通滤波器
High pass filter	高通滤波器
Band pass filter	带通滤波器
Band stop filter	带阻滤波器

Z transform 1

English	Chinese
difference equation	差分方程
z-transform	z 变换
rectangular approximation	矩形近似
discrete time LTI system	离散时间 LTI 系统
bilateral z-transform	双边 z 变换
unilateral z-transform	单边 z 变换
region of convergence	收敛区域
unit impulse sequence	单位脉冲序列

unit step sequence	单位步长序列

Z transform 2

English	Chinese
inverse z transform	逆 z 变换
discrete time LTI system	离散时间 LTI 系统
block diagram	方框图
causal system	因果系统
unilateral z transform	单边 z 变换
power series expansion	电源系列扩展
partial fraction expansion	部分分数展开
impulse response	脉冲响应
linear constant coefficient -	线性常数系数
difference equation	差分方程
system interconnection	系统互联互通

Discrete Fourier transform

English	Chinese
Discrete Fourier Transform	离散傅里叶变换
Discrete Fourier Series	离散傅里叶级数
Fourier Coefficients	傅里叶系数
periodic sequence	周期序列
successive values	连续值
spectra coefficients	光谱系数
duality	二重性
Parseval's Theorem	帕斯瓦尔定理
Fourier Transform Pair	傅里叶变换对
Fourier Spectra	傅里叶光谱

Filters Design

English	Chinese
analogue filter and digital filter	模拟滤波器和数字滤波器
implementation	实现
approximate numerical integration technique	近似数值积分技术
FIR and IIR digital filters	FIR 和 IIR 数字滤波器
butterworth filter	巴特沃斯过滤器
low pass filter	低通滤波器
high pass filter	高通滤波器
bandpass filter	带通滤波器
numerical integration	数值积分
bilinear transformation	双线性变换
Tustin's method	塔斯汀的方法

finite impulse response	有限脉冲响应
infinite impulse response	无限脉冲响应

(2) 重要公式列表

A signal $x(t)$ or $x[n]$ is referred to as an even signal if

$$x(-t) = x(t)$$
$$x[-n] = x[n]$$

A signal $x(t)$ or $x[n]$ is referred to as an odd signal if

$$x(-t) = -x(t)$$
$$x[-n] = -x[n]$$

A continuous-time signal x(t) is said to be periodic with period T if there is a positive nonzero value of T for which

For analogue signals:
$x(t + T) = x(t)$ all t
$x(t + mT) = x(t)$

For digital signals:
$x[n + N] = x[n]$ all n
$x[n + mN] = x[n]$

Convolution:

$$y[n] = \sum_{k=-\infty}^{+\infty} x[k]h[n-k] = x[n] * h[n] \quad (2.39)$$

$$y(t) = \int_{-\infty}^{+\infty} x(\tau)h(t-\tau)d\tau = x(t) * h(t) \quad (2.40)$$

Laplace transform:

For a general continuous-time signal x(t), the Laplace transform X(s) is defined as

$$X(s) = \int_{-\infty}^{\infty} x(t)e^{-st}dt \quad (3.3)$$

where:

$$s = \sigma + j\omega \quad (3.4)$$

Laplace Inverse Transform:

$$x(t) = \mathcal{L}^{-1}\{X(s)\} \tag{3.24}$$

$$x(t) = \frac{1}{2\pi j}\int_{c-j\infty}^{c+j\infty} X(s)e^{st}\,ds \tag{3.25}$$

Fourier Series (original complex exponential form):

$$x(t) = \sum_{k=-\infty}^{\infty} c_k e^{jk\omega_0 t} \qquad \omega_0 = \frac{2\pi}{T_0} \tag{5.4}$$

$$c_k = \frac{1}{T_0}\int_{T_0} x(t)\, e^{-jk\omega_0 t}\, dt \tag{5.5}$$

$$c_0 = \frac{1}{T_0}\int_{T_0} x(t)\, dt \tag{5.6}$$

Trigonometric Fourier Series:

$$x(t) = \frac{a_0}{2} + \sum_{k=1}^{\infty} (a_k \cos k\omega_0 t + b_k \sin k\omega_0 t) \qquad \omega_0 = \frac{2\pi}{T_0} \tag{5.8}$$

$$a_k = \frac{2}{T_0}\int_{T_0} x(t) \cos k\omega_0 t\, dt \tag{5.9a}$$

$$b_k = \frac{2}{T_0}\int_{T_0} x(t) \sin k\omega_0 t\, dt \tag{5.9b}$$

Fourier Transform:

$$X(\omega) = \mathcal{F}\{x(t)\} = \int_{-\infty}^{\infty} x(t)e^{j\omega t}\,dt \tag{5.31}$$

$$x(t) = \mathcal{F}^{-1}\{X(\omega)\} = \frac{1}{2\pi}\int_{-\infty}^{\infty} X(\omega)e^{j\omega t}\,d\omega \tag{5.32}$$

Fourier Spectrum:

$$X(\omega) = |X(\omega)|\, e^{j\phi(\omega)} \tag{5.34}$$

Z transform:

$$X(z) = \sum_{n=-\infty}^{\infty} x[n] z^{-n} \tag{4.3}$$

Inverse Z Transform:

$$x[n] = \frac{1}{2\pi j} \oint_C X(z) z^{n-1} \, dz \tag{4.28}$$

Discrete Fourier Series:

$$x[n] = \sum_{k=\langle N_0 \rangle} c_k \, e^{jk\Omega_0 n} \qquad \Omega_0 = \frac{2\pi}{N_0} \tag{6.9}$$

$$c_k = \frac{1}{N_0} \sum_{n=\langle N_0 \rangle} x[n] \, e^{-jk\Omega_0 n} \tag{6.10}$$

$$c_0 = \frac{1}{N_0} \sum_{n=\langle N_0 \rangle} x[n] \tag{6.11}$$

Discrete Fourier transform:

$$X(\Omega) = \mathcal{F}\{x[n]\} = \sum_{n=-\infty}^{\infty} x[n] \, e^{-j\Omega n} \tag{6.27}$$

$$x[n] = \mathcal{F}^{-1}\{X(\Omega)\} = \frac{1}{2\pi} \int_{2\pi} X(\Omega) \, e^{j\Omega n} \, d\Omega \tag{6.28}$$

Discrete Fourier Spectrum

$$X(\Omega) = \left| X(\Omega) \right| e^{j\phi(\Omega)} \tag{6.30}$$

(3) 参考列表

Laplace transform for some common signals

$x(t)$	$X(s)$	ROC
$\delta(t)$	1	All s
$u(t)$	$\frac{1}{s}$	$\mathrm{Re(s)} > 0$
$-u(-t)$	$\frac{1}{s}$	$\mathrm{Re(s)} < 0$
$tu(t)$	$\frac{1}{s^2}$	$\mathrm{Re}(s) > 0$
$t^k u(t)$	$\frac{\mathrm{k!}}{s^{k+1}}$	$\mathrm{Re}(s) > 0$
$e^{-at} u(t)$	$\frac{1}{s+a}$	$\mathrm{Re}(s) > -\mathrm{Re}(a)$
$-e^{-at} u(-t)$	$\frac{1}{s+a}$	$\mathrm{Re}(s) < -\mathrm{Re}(a)$
$te^{-at} u(t)$	$\frac{1}{(s+a)^2}$	$\mathrm{Re}(s) > -\mathrm{Re}(a)$
$-te^{-at}u(-t)$	$\frac{1}{(s+a)^2}$	$\mathrm{Re}(s) < -\mathrm{Re}(a)$
$\cos \omega_0 tu(t)$	$\frac{s}{s^2+\omega_0^2}$	$\mathrm{Re}(s) > 0$
$\sin \omega_0 tu(t)$	$\frac{\omega_0}{s^2+\omega_0^2}$	$\mathrm{Re}(s) > 0$
$e^{-at} \cos \omega_0 tu(t)$	$\frac{s+a}{(s+a)^2+\omega_0^2}$	$\mathrm{Re}(s) > -\mathrm{Re}(a)$
$e^{-at} \sin \omega_0 tu(t)$	$\frac{\omega_0}{(s+a)^2+\omega_0^2}$	$\mathrm{Re}(s) > -\mathrm{Re}(a)$

Properties of Laplace transform

PROPERTY	SIGNAL	TRANSFORM	ROC
	$x(t)$	$X(s)$	R
	$x_1(t)$	$X_1(s)$	R_1
	$x_2(t)$	$X_2(s)$	R_2
Linearity	$a_1x_1(t) + a_2x_2(t)$	$a_1X_1(s) + a_2X_2(s)$	$R' \supset R_1 \cap R_2$
Time shifting	$x(t-t_0)$	$e^{-st_0}X(s)$	$R'=R$
Shifting in s	$e^{s_0t}x(t)$	$X(s-s_0)$	$R'=R+\mathrm{Re}(s_0)$
Time scaling	$x(at)$	$\frac{1}{\lvert a\rvert}X(a)$	$R'=aR$
Time reversal	$x(-t)$	$X(-s)$	$R'=-R$
Differentiation in t	$\frac{dx(t)}{dt}$	$sX(s)$	$R' \supset R$
Differentiation in s	$-tx(t)$	$\frac{dX(s)}{ds}$	$R'=R$
Integration	$\int_{-\infty}^{t} x(\tau)\,d\tau$	$\frac{1}{s}X(s)$	$R' \supset R \cap \{\mathrm{Re}(s) > 0\}$
Convolution	$x_1(t) * x_2(t)$	$X_1(s)\,X_2(s)$	$R' \supset R_1 \cap R_2$

Properties of Fourier transform

PROPERTY	SIGNAL	FOURIER TRANSFORM
	$x(t)$	$X(\omega)$
	$x_1(t)$	$X_1(\omega)$
	$x_2(t)$	$X_2(\omega)$
Linearity	$a_1x_1(t) + a_2x_2(t)$	$a_1X_1(\omega) + a_2X_2(\omega)$
Time shifting	$x(t-t_0)$	$e^{-j\omega t_0}X(\omega)$
Frequency shifting	$e^{j\omega_0 t}x(t)$	$X(\omega-\omega_0)$
Time scaling	$x(at)$	$\frac{1}{\lvert a\rvert}X\left(\frac{\omega}{a}\right)$
Time reversal	$x(-t)$	$X(-\omega)$
Duality	$X(t)$	$2\pi x(-\omega)$
Time differentiation	$\frac{dx(t)}{dt}$	$j\omega X(\omega)$
Frequency differentiation	$(-jt)x(t)$	$\frac{dX(\omega)}{d\omega}$
Integration	$\int_{-\infty}^{t} x(\tau)\,d\tau$	$\pi X(0)\,\delta(\omega)+\frac{1}{j\omega}X(\omega)$
Convolution	$x_1(t) * x_2(t)$	$X_1(\omega)X_2(\omega)$
Multiplication	$x_1(t)x_2(t)$	$\frac{1}{2\pi}X_1(\omega) * X_2(\omega)$
Real signal	$x(t) = x_e(t) + x_o(t)$	$X(\omega) = A(\omega) + jB(\omega)$ $X(-\omega) = X^*(\omega)$
Even component	$x_e(t)$	$\mathrm{Re}\{X(\omega)\} = A(\omega)$
Odd component	$x_o(t)$	$j\,\mathrm{Im}\{X(\omega)\} = jB(\omega)$
Parseval's relations		
	$\int_{-\infty}^{\infty} x_1(\lambda)X_2(\lambda)\,d\lambda = \int_{-\infty}^{\infty} X_1(\lambda)x_2(\lambda)\,d\lambda$	
	$\int_{-\infty}^{\infty} x_1(t)x_2(t)\,dt = \frac{1}{2\pi}\int_{-\infty}^{\infty} X_1(\omega)X_2(-\omega)\,d\omega$	
	$\int_{-\infty}^{\infty} \lvert x(t)\rvert^2\,dt = \frac{1}{2\pi}\int_{-\infty}^{\infty} \lvert X(\omega)\rvert^2\,d\omega$	

Fourier Transform of some common signals

$x(t)$	$X(\omega)$
$\delta(t)$	1
$\delta(t-t_0)$	$e^{-j\omega t_0}$
1	$2\pi\delta(\omega)$
$e^{j\omega_0 t}$	$2\pi\delta(\omega-\omega_0)$
$\cos\omega_0 t$	$\pi[\delta(\omega-\omega_0)+\delta(\omega+\omega_0)]$
$\sin\omega_0 t$	$-j\pi[\delta(\omega-\omega_0)-\delta(\omega+\omega_0)]$
$u(t)$	$\pi\delta(\omega)+\frac{1}{j\omega}$
$u(-t)$	$\pi\delta(\omega)-\frac{1}{j\omega}$
$e^{-at}u(t), a>0$	$\frac{1}{j\omega+a}$
$te^{-at}u(t), a>0$	$\frac{1}{(j\omega+a)^2}$
$e^{-a\lvert t\rvert}, a>0$	$\frac{2a}{a^2+\omega^2}$
$\frac{1}{a^2+t^2}$	$e^{-a\lvert\omega\rvert}$
$e^{-at^2}, a>0$	$\sqrt{\frac{\pi}{a}}\,e^{-\omega^2/4a}$
$p_a(t)=\begin{cases}1 & \lvert t\rvert<a\\ 0 & \lvert t\rvert>a\end{cases}$	$2a\frac{\sin\omega a}{\omega a}$
$\frac{\sin at}{\pi t}$	$p_a(\omega)=\begin{cases}1 & \lvert\omega\rvert<a\\ 0 & \lvert\omega\rvert>a\end{cases}$
$\operatorname{sgn} t$	$\frac{2}{j\omega}$
$\sum_{k=-\infty}^{\infty}\delta(t-kT)$	$\omega_0\sum_{k=-\infty}^{\infty}\delta(\omega-k\omega_0), \omega_0=\frac{2\pi}{T}$

Filters design – integration approximation methods

Table 5.1. Substitutions for Various Integration Methods

Method	
Forward rectangular	$s = (z - 1)/T$
Backward rectangular	$s = (z - 1)/Tz$
Trapezoidal (bilinear transformation)	$s = 2(z - 1)/T(z + 1)$

Some common z transform pairs

$x[n]$	$X(z)$	ROC
$\delta[n]$	1	All z
$u[n]$	$\frac{1}{1-z^{-1}}, \frac{z}{z-1}$	$\lvert z\rvert > 1$
$-u[-n-1]$	$\frac{1}{1-z^{-1}}, \frac{z}{z-1}$	$\lvert z\rvert < 1$
$\delta[n-m]$	z^{-m}	All z except 0 if $(m > 0)$ or ∞ if $(m < 0)$
$a^n u[n]$	$\frac{1}{1-az^{-1}}, \frac{z}{z-a}$	$\lvert z\rvert > \lvert a\rvert$
$-a^n u[-n-1]$	$\frac{1}{1-az^{-1}}, \frac{z}{z-a}$	$\lvert z\rvert < \lvert a\rvert$
$na^n u[n]$	$\frac{az^{-1}}{(1-az^{-1})^2}, \frac{az}{(z-a)^2}$	$\lvert z\rvert > \lvert a\rvert$
$-na^n u[-n-1]$	$\frac{az^{-1}}{(1-az^{-1})^2}, \frac{az}{(z-a)^2}$	$\lvert z\rvert < \lvert a\rvert$
$(n+1)a^n u[n]$	$\frac{1}{(1-az^{-1})^2}, \left[\frac{z}{z-a}\right]^2$	$\lvert z\rvert > \lvert a\rvert$
$(\cos \Omega_0 n)u[n]$	$\frac{z^2-(\cos \Omega_0)z}{z^2-(2\cos \Omega_0)z+1}$	$\lvert z\rvert > 1$
$(\sin \Omega_0 n)u[n]$	$\frac{(\sin \Omega_0)z}{z^2-(2\cos \Omega_0)z+1}$	$\lvert z\rvert > 1$

Properties of z transform

PROPERTY	SEQUENCE	TRANSFORM	ROC
	$x[n]$	$X(z)$	R
	$x_1[n]$	$X_1(z)$	R_1
	$x_2[n]$	$X_2(z)$	R_2
Linearity	$a_1x_1[n] + a_2x_2[n]$	$a_1X_1(z) + a_2X_2(z)$	$R' \supset R_1 \cap R_2$
Time shifting	$x[n-n_0]$	$z^{-n_0}X(z)$	$R' \supset R \cap \{0 < \lvert z\rvert < \infty\}$
Multiplication by z_0^n	$z_0^n x[n]$	$X\left(\frac{z}{z_0}\right)$	$R' = \lvert z_0\rvert R$
Multiplication by $e^{j\Omega_0 n}$	$e^{j\Omega_0 n}x[n]$	$X(e^{-j\Omega_0}z)$	$R' = R$
Time reversal	$x[-n]$	$X\left(\frac{1}{z}\right)$	$R' = \frac{1}{R}$
Multiplication by n	$nx[n]$	$-z\frac{dX(z)}{dz}$	$R' = R$
Accumulation	$\sum_{k=-\infty}^{n} x[n]$	$\frac{1}{1-z^{-1}}X(z)$	$R' \supset R \cap \{\lvert z\rvert > 1\}$
Convolution	$x_1[n] * x_2[n]$	$X_1(z)X_2(z)$	$R' \supset R_1 \cap R_2$