# List of Symbols and Abbreviations

## Symbols

| | | |
|---|---|---|
| $a_o$, $a_n$, $b_n$ | - | Fourier coefficients of trigonometric form of Fourier series of x(t) |
| B | - | Bandwidth in Hz |
| $C_n$ | - | Fourier coefficients of exponential form of Fourier series of x(t) |
| $c_k$ | - | Fourier coefficients of discrete time signal x(n) |
| E | - | Energy of a signal |
| f | - | Frequency of discrete time signal in Hz/sample |
| F | - | Frequency of continuous time signal in Hz |
| $F_o$ | - | Fundamental frequency of continuous time signal in Hz |
| $F_m$ | - | Maximum frequency of continuous time signal |
| $F_s$ | - | Sampling frequency of continuous time signal in Hz |
| $\mathcal{H}$ | - | System operator |
| j | - | Complex operator, $\sqrt{-1}$ |
| L | - | Inductance |
| $n\Omega_o$ | - | Harmonic angular frequency, where n = 1,2,3..... |
| P | - | Power of a signal |
| p | - | Pole |
| R | - | Resistor |
| s | - | Complex frequency ($s = \sigma + j\Omega$) |
| t | - | Time in seconds |
| T | - | Time period in seconds |
| W | - | Phase factor or Twiddle factor |
| z | - | Complex variable ($z = u + jv$) |
| z | - | Unit advance operator or zero |
| $z^{-1}$ | - | Unit delay operator |
| $\Omega$ | - | Angular frequency of continuous time signal in rad/sec |
| $\Omega_o$ | - | Fundamental angular frequency |
| $\Omega_{max}$ | - | Maximum angular frequency in rad/sec |
| $\omega$ | - | Angular frequency of discrete time signal |
| $\omega_k$ | - | Sampling frequency point |
| $\sigma$ | - | Neper frequency (Real part of s) |
| * | - | Convolution operator |
| * | - | Circular convolution operator |
| $\oint$ | - | Integration operator |
| $\frac{d}{dt}$ | - | Differentiation operator |

## Standard/Input/Output Signals

| | | |
|---|---|---|
| $h(n)$ | - | Impulse response of discrete time system |
| $h(t)$ | - | Impulse response of continuous time system |
| $r_{xy}(m)$ | - | Cross-correlation sequence of x(n) and y(n) |
| $r_{xx}(m)$ | - | Auto-correlation sequence of x(n) |
| $\bar{r}_{xy}(m)$ | - | Circular cross-correlation sequence of x(n) and y(n) |
| $\bar{r}_{xx}(m)$ | - | Circular auto-correlation sequence of x(n) |
| $sgn(t)$ | - | Signum signal |
| $sinc\ (t)$ | - | Sinc signal |
| $u(n)$ | - | Discrete time unit step signal |
| $u(t)$ | - | Continuous time unit step signal |
| $x(n)$ | - | Discrete time signal |
| $x(n)$ | - | Input of discrete time system |
| $x_o(n)$ | - | Odd part of discrete time signal x(n) |
| $x_e(n)$ | - | Even part of discrete-time signal x(n) |
| $x(n–m)$ | - | Delayed or linearly shifted x(n) by m units |
| $x((n–m))_N$ | - | Circularly shifted x(n) by m units, where N is period |
| $x(t)$ | - | Continuous time signal or Input of continuous time system |
| $x_o(t)$ | - | Odd part of continuous time signal x(t) |
| $x_e(t)$ | - | Even part of continuous time signal x(t) |
| $x(t–m)$ | - | Delayed or linearly shifted x(t) by m units |
| $y(n)$ | - | Output / Response of discrete time system |
| $y_{zs}(n)$ | - | Zero state response of discrete time system |
| $y_{zi}(n)$ | - | Zero input response of discrete time time system |
| $y(t)$ | - | Output / Response of continuous time system |
| $y_{zs}(t)$ | - | Zero state response of continuous time system |
| $y_{zi}(t)$ | - | Zero input response of continuous time system |
| $\delta(t)$ | - | Continuous time impulse signal |
| $\delta(n)$ | - | Discrete time impulse signal |
| $\Pi(t)$ | - | Unit pulse signal |

## Transform Operators and Functions

| | | |
|---|---|---|
| $\mathcal{DFT}$ | - | Discrete Fourier Transform (DFT) |
| $\mathcal{DFT}^{-1}$ | - | Inverse DFT |
| $\mathcal{F}$ | - | Fourier Transform |
| $\mathcal{F}^{-1}$ | - | Inverse Fourier Transform |
| $H(s)$ | - | Laplace Transform of h(t) |
| $\mathcal{L}$ | - | Laplace Transform |
| $\mathcal{L}^{-1}$ | - | Inverse Laplace Transform |
| $X(e^{j\omega})$ | - | Discrete Time Fourier Transform of x(n) |
| $X_r(e^{j\omega})$ | - | Real part of $X(e^{j\omega})$ |
| $X_i(e^{j\omega})$ | - | Imaginary part of $X(e^{j\omega})$ |

| | | |
|---|---|---|
| $X(j\Omega)$ | - | Fourier Transform of x(t) |
| X(k) | - | Discrete Fourier Transform of x(k) |
| $X_r(k)$ | - | Real part of X(k) |
| $X_i(k)$ | - | Imaginary part of X(k) |
| X(s) | - | Laplace Transform of x(t) |
| X(z) | - | $\mathcal{Z}$-transform of x(n) |
| $\mathcal{Z}$ | - | $\mathcal{Z}$-transform |
| $\mathcal{Z}^{-1}$ | - | Inverse $\mathcal{Z}$-transform |

## Matrices and Vectors

| | | |
|---|---|---|
| **A** | - | System matrix |
| $\mathbf{A}^n$ | - | State transition matrix of discrete time state model |
| **B** | - | Input matrix |
| **C** | - | Output matrix |
| **D** | - | Transmission matrix |
| $e^{\mathbf{A}t}$ | - | State transition matrix of continuous time state model |
| **I** | - | Identity / Unit matrix |
| **Q**(t) | - | State vector of continuous time state model |
| **Q**(n) | - | State vector of discrete time state model |
| $\dot{\mathbf{Q}}(t)$ | - | First derivative of continuous time state vector |
| $\dot{\mathbf{Q}}(n)$ | - | First derivative of discrete time state vector |
| **X**(t) | - | Input vector of continuous time state model |
| **X**(n) | - | Input vector of discrete time state model |
| **Y**(t) | - | Output vector of continuous time state model |
| **Y**(n) | - | Output vector of discrete time state model |

## Abbreviations

| | | |
|---|---|---|
| BIBO | - | **B**ounded **I**nput **B**ounded **O**utput |
| CT | - | **C**ontinuous **T**ime |
| CTFS | - | **C**ontinuous **T**ime **F**ourier **S**eries |
| CTFT | - | **C**ontinuous **T**ime **F**ourier **T**ransform |
| DFT | - | **D**iscrete **F**ourier **T**ransform |
| DIF | - | **D**ecimation **I**n **F**requency |
| DIT | - | **D**ecimation **I**n **T**ime |
| DT | - | **D**iscrete **T**ime |
| DTFS | - | **D**iscrete **T**ime **F**ourier **S**eries |
| DTFT | - | **D**iscrete **T**ime **F**ourier **T**ransform |
| FFT | - | **F**ast **F**ourier **T**ransform |
| FIR | - | **F**inite **I**mpulse **R**esponse |
| IIR | - | **I**nfinite **I**mpulse **R**esponse |
| LHP | - | **L**eft **H**alf **P**lane |
| LTI | - | **L**inear **T**ime **I**nvariant |
| RHP | - | **R**ight **H**alf **P**lane |
| ROC | - | **R**egion **O**f **C**onvergence |