FORMULÁRIO – M008

RELAÇÕES TRIGONOMÉTRICAS:

$$\cos(\theta) = \frac{e^{j\theta} + e^{-j\theta}}{2}$$

$$\text{sen}(\theta) = \frac{e^{j\theta} - e^{-j\theta}}{2j}$$

$$\cos(a \pm b) = \cos(a)\cos(b) \mp \text{sen}(a)\,\text{sen}(b)$$

$$\text{sen}(a \pm b) = \text{sen}(a)\cos(b) \pm \text{sen}(b)\cos(a)$$

$$\text{sen}^2(x) + \cos^2(x) = 1$$

$$\text{sen}^2(x) = \frac{1 - \cos(2x)}{2}$$

$$\cos^2(x) = \frac{1 + \cos(2x)}{2}$$

$$\text{sen}(2x) = 2\,\text{sen}(x)\cos(x)$$

$$\text{sen}(x)\cos(y) = \frac{1}{2}\text{sen}(x-y) + \frac{1}{2}\text{sen}(x+y)$$

$$\text{sen}(x)\,\text{sen}(y) = \frac{1}{2}\cos(x-y) - \frac{1}{2}\cos(x+y)$$

$$\cos(x)\cos(y) = \frac{1}{2}\cos(x-y) + \frac{1}{2}\cos(x+y)$$

PRINCIPAIS DIRETIVAS DE DERIVAÇÃO E INTEGRAÇÃO:

$$\frac{d}{dx}[K] = 0$$

$$\frac{d}{dx}[K \cdot f(x)] = K \cdot f'(x)$$

$$\frac{d}{dx}\left[f(x)^m\right] = m \cdot f(x)^{m-1} \cdot f'(x)$$

$$\frac{d}{dx}\left[a^{f(x)}\right] = a^{f(x)} \cdot \ln(a) \cdot f'(x)$$

$$\frac{d}{dx}\left[\log_a(f(x))\right] = \frac{f'(x)}{\ln(a) \cdot f(x)}$$

$$\frac{d}{dx}\left[sen(f(x))\right] = \cos(f(x)) \cdot f'(x)$$

$$\frac{d}{dx}\left[\cos(f(x))\right] = -sen(f(x)) \cdot f'(x)$$

$$\frac{d}{dx}\left[tg(f(x))\right] = \sec^2(f(x)) \cdot f'(x)$$

$$\frac{d}{dx}\left[\cot g(f(x))\right] = -\cos\sec^2(f(x)) \cdot f'(x)$$

$$\frac{d}{dx}\left[f(x) \cdot g(x)\right] = f'(x) \cdot g(x) + f(x) \cdot g'(x)$$

$$\int K \cdot dx = Kx + C$$

$$\int f(x)^m \cdot f'(x) \cdot dx = \frac{f(x)^{m+1}}{m+1} + C$$

$$\int a^{f(x)} \cdot f'(x) \cdot dx = \frac{a^{f(x)}}{\ln(a)} + C$$

$$\int \frac{f'(x)}{f(x)} \cdot dx = \ln(f(x)) + C$$

$$\int sen(f(x)) \cdot f'(x) \cdot dx = -\cos(f(x)) + C$$

$$\int \cos(f(x)) \cdot f'(x) \cdot dx = sen(f(x)) + C$$

$$\int tg(f(x)) \cdot f'(x) \cdot dx = \ln[\sec(f(x))] + C$$

$$\int \sec^2(f(x)) \cdot f'(x) \cdot dx = tg(f(x)) + C$$

$$\int \cos\sec^2(f(x)) \cdot f'(x) \cdot dx = -\cot g(f(x)) + C$$

$$\int \frac{f'(x)}{a^2 + f(x)^2} \cdot dx = \frac{1}{a} arctg\left(\frac{f(x)}{a}\right) + C$$

$$\int u \cdot dv = u \cdot v - \int v \cdot du$$

FÓRMULAS DE PROCESSOS ESTOCÁSTICOS

$$R_X(t_1, t_2) = E\left[X(t_1)X(t_2)\right] = \overline{X(t_1)X(t_2)} = \overline{X_1X_2}$$

$$R_X(t, t+\tau) = E\left[X(t)X(t+\tau)\right] = \overline{X(t)X(t+\tau)}$$

$$G(f) = \int_{-\infty}^{\infty} g(t)e^{-j2\pi ft}dt$$

$$\text{g(t)} = \int_{-\infty}^{\infty} G(f)e^{j2\pi ft}df$$

$$G(\omega) = \int_{-\infty}^{\infty} g(t)e^{-j\omega t}dt$$

$$\text{g(t)} = \frac{1}{2\pi}\int_{-\infty}^{\infty} G(\omega)e^{j\omega t}d\omega$$

$$R_X(\tau) \overset{\Im}{\leftrightarrow} S_X(f)$$

$$R_Y(\tau) \overset{\Im}{\leftrightarrow} S_Y(f)$$

$$R_X(\tau) \overset{\Im}{\leftrightarrow} S_X(\omega)$$

$$R_Y(\tau) \overset{\Im}{\leftrightarrow} S_Y(\omega)$$

$S_Y(f) = S_X(f) \cdot |H(f)|^2$

$S_Y(\omega) = S_X(\omega) \cdot |H(\omega)|^2$

$$P_X = \overline{X^2} = R_X(0) = \int_{-\infty}^{+\infty} S_X(f)df = \frac{1}{2\pi}\int_{-\infty}^{+\infty} S_X(\omega)d\omega$$

$$P_Y = \overline{Y^2} = R_Y(0) = \int_{-\infty}^{+\infty} S_Y(f)df = \frac{1}{2\pi}\int_{-\infty}^{+\infty} S_Y(\omega)d\omega$$

$$R_{XY}(t, t+\tau) = \overline{X(t)Y(t+\tau)}$$

$$E[Y(t)] = E[X(t)] \cdot \int_{-\infty}^{\infty} h(t)dt = E[X(t)] \cdot H(0)$$

$$R_{XY}(\tau) \leftrightarrow S_{XY}(f)$$

$$R_{XY}(\tau) = \int_{-\infty}^{\infty} h(u)R_X(\tau - u)du = h(\tau) * R_X(\tau)$$

$$S_{XY}(f) = H(f) \cdot S_X(f) \qquad S_{XY}(\omega) = H(\omega) \cdot S_X(\omega)$$

$$R_Y(\tau) = \int_{-\infty}^{\infty} h(-w)R_{XY}(\tau - w)dw = h(-\tau) * R_{XY}(\tau)$$

$$S_Y(f) = H^*(f) \cdot S_{XY}(f) \qquad S_Y(\omega) = H^*(\omega) \cdot S_{XY}(\omega)$$

PROPRIEDADES DA TRANSFORMADA DE FOURIER

Propriedade	$x(t)$	$X(w)$	$X(f)$
Espelhamento	$x(-t)$	$X(-w)$	$X(-f)$
Simetria	$X(t)$	$2\pi \cdot x(-w)$	$x(-f)$
Escalonamento	$x(at)$	$\frac{1}{\|a\|}X\left(\frac{w}{a}\right)$	$\frac{1}{\|a\|}X\left(\frac{f}{a}\right)$
Deslocamento no tempo	$x(t-d)$	$X(w)e^{-jwd}$	$X(f)e^{-j2\pi fd}$
Derivação no tempo	$\frac{d^n}{dt^n}x(t)$	$(jw)^n X(w)$	$(j2\pi f)^n X(f)$
Integração no tempo	$\int_{-\infty}^{t} x(\lambda)d\lambda$	$\frac{1}{jw}X(w) + \pi X(0)\delta(w)$	$\frac{1}{j2\pi f}X(f) + \frac{1}{2}X(0)\delta(f)$
Deslocamento na frequência	$x(t)e^{jw_0 t}$	$X(w - w_0)$	$X(f - f_0)$
Derivação na freqüência	$(-jt)^n x(t)$	$\frac{d^n}{dw^n}X(w)$	$\left(\frac{1}{2\pi}\right)^n \frac{d^n}{dw^n}X(f)$
Convolução no tempo	$x(t) * h(t)$	$X(w)H(w)$	$X(f)H(f)$
Convolução na frequência	$x(t)h(t)$	$\frac{1}{2\pi}X(w) * H(w)$	$X(f) * H(f)$
Modulação	$x(t)\cos(w_0 t)$	$\frac{1}{2}X(w + w_0) + \frac{1}{2}X(w - w_0)$	$\frac{1}{2}X(f + f_0) + \frac{1}{2}X(f - f_0)$

PRINCIPAIS PARES DE TRANSFORMADA DE FOURIER

$x(t)$	$X(w)$	$X(f)$
$\delta(t)$	1	1
A	$2\pi A\delta(w)$	$A\delta(f)$
$e^{-at}u(t)$ $a>0$	$\dfrac{1}{a+jw}$	$\dfrac{1}{a+j2\pi f}$
$e^{-a\lvert t\rvert}$	$\dfrac{2a}{a^2+w^2}$	$\dfrac{2a}{a^2+(2\pi f)^2}$
$u(t)$	$\pi\delta(w)+\dfrac{1}{jw}$	$\dfrac{1}{2}\delta(f)+\dfrac{1}{j2\pi f}$
$\operatorname{sgn}(t)=\dfrac{\lvert t\rvert}{\tau}$	$\dfrac{2}{jw}$	$\dfrac{1}{j\pi f}$
e^{jw_0t}	$2\pi\delta(w-w_0)$	$\delta(f-f_0)$
$\cos(w_0t)$	$\pi\delta(w+w_0)+\pi\delta(w-w_0)$	$\dfrac{1}{2}\delta(f+f_0)+\dfrac{1}{2}\delta(f-f_0)$
$\operatorname{sen}(w_0t)$	$j\pi\delta(w+w_0)-j\pi\delta(w-w_0)$	$\dfrac{j}{2}\delta(f+f_0)-\dfrac{j}{2}\delta(f-f_0)$
$\operatorname{rect}\left(\dfrac{t}{\tau}\right)=\begin{cases}1\\0\end{cases}$ $\lvert t\rvert<\tau/2$ $\lvert t\rvert>\tau/2$	$\tau\cdot\operatorname{Sa}\left(\dfrac{w\tau}{2}\right)$	$\tau\cdot\operatorname{Sa}(\pi\cdot\tau\cdot f)$