Useful Mathematical Relations

$$|a+jb| = \sqrt{a^2+b^2}\ ,\ \angle(a+jb) = \tan^{-1}\left(\frac{b}{a}\right).$$

$$\left|\frac{1}{a+jb}\right| = \frac{1}{\sqrt{a^2+b^2}}\ ,\ \angle\frac{1}{(a+jb)} = -\tan^{-1}\left(\frac{b}{a}\right).$$

$$e^x = 1 + x + \frac{x^2}{2!} + \frac{x^3}{3!} + \frac{x^4}{4!} + \ldots\ldots$$

$$\sin(x) = x - \frac{x^3}{3!} + \frac{x^5}{5!} - \frac{x^7}{7!} + \ldots\ldots \qquad \cos(x) = 1 - \frac{x^2}{2!} + \frac{x^4}{4!} - \frac{x^6}{6!} + \ldots\ldots$$

$$\sin(-x) = -\sin(x)$$

$$\cos(-x) = \cos(x)$$

$$e^{jx} = \cos(x) + j\sin(x)$$

$$\cos(x) = \frac{e^{jx} + e^{-jx}}{2}$$

$$\sin(x) = \frac{e^{jx} - e^{-jx}}{j2}$$

$$\cos^2(x) + \sin^2(x) = 1$$

$$\cos(x)\cos(y) = \frac{1}{2}\left[\cos(x-y) + \cos(x+y)\right]$$

$$\sin(x)\sin(y) = \frac{1}{2}\left[\cos(x-y) - \cos(x+y)\right]$$

$$\sin(x)\cos(y) = \frac{1}{2}\left[\sin(x-y) + \sin(x+y)\right]$$

$$\cos(x+y) = \cos(x)\cos(y) - \sin(x)\sin(y)$$

$$\sin(x+y) = \sin(x)\cos(y) + \cos(x)\sin(y)$$

$$A\cos(x) + B\sin(x) = \sqrt{A^2+B^2}\cos\left(x - \tan^{-1}\left(\frac{B}{A}\right)\right)$$

$$\frac{d}{dx}\left[\tan^{-1}(x)\right] = \frac{1}{1+x^2}$$

$$\int_0^a \frac{1}{1+x^2}\,dx = \tan^{-1}(a)$$

$$\int u\,dv = uv - \int v\,du$$

$$\int_b^a e^{mx}\,dx = \frac{1}{m}e^{mx}\Big|_b^a$$

$$\int_b^a \sin(mx)\,dx = \frac{-\cos(mx)}{m}\Big|_b^a = \frac{1}{m}\left[\cos(bx) - \cos(ax)\right]$$

$$\int_b^a \cos(mx)\,dx = \frac{\sin(mx)}{m}\Big|_b^a = \frac{1}{m}\left[\sin(ax) - \sin(bx)\right]$$