Integration Formulas

$$\oint_C \mathbf{u}\cdot dr = \int\int_R \frac{\partial u_2}{\partial x} - \frac{\partial u_1}{\partial y} dx\, dy$$

$$\oint_C \mathbf{u}\cdot d\mathbf{r} = \oiint_S (\nabla\times\mathbf{u})\cdot\mathbf{n}\, dS$$

$$\oiint_S \mathbf{u}\cdot\mathbf{n}\, dS = \iiint_V \nabla\cdot\mathbf{u}\, dV$$

Fourier Sine Series

$$f(x) = \sum_{i=1}^{\infty} b_n \sin(\frac{n\pi}{l}x), \quad b_n = \frac{2}{l}\int_0^l f(x)\sin(\frac{n\pi}{l}x)\, dx, \quad \text{on } 0\le x\le l.$$

Fourier Cosine Series

$$f(x) = a_0 + \sum_{i=1}^{\infty} a_n \cos(\frac{n\pi}{l}x), \quad a_0 = \frac{1}{l}\int_0^l f(x)dx, \quad a_n = \frac{2}{l}\int_0^l f(x)\cos(\frac{n\pi}{l}x)\, dx, \quad \text{on } 0\le x\le l.$$

Fourier Series

$$f(x) = a_0 + \sum_{i=1}^{\infty}\left[a_n\cos(\frac{n\pi}{l}x) + b_n\sin(\frac{n\pi}{l}x)\right], \quad , \quad \text{on } -l\le x\le l.$$

$$\begin{aligned} a_0 &= \frac{1}{2l}\int_{-l}^{l} f(x)dx, \quad a_n = \frac{1}{l}\int_{-l}^{l} f(x)\cos(\frac{n\pi}{l}x)\, dx, \\ b_n &= \frac{1}{l}\int_{-l}^{l} f(x)\sin(\frac{n\pi}{l}x)\, dx. \end{aligned}$$

Orthogonality Conditions

$$\begin{matrix} \int_0^L \sin\frac{n\pi}{L}x\sin\frac{m\pi}{L}xdx \\ \int_0^L \cos\frac{n\pi}{L}x\cos\frac{m\pi}{L}xdx \end{matrix} = \begin{cases} 0 & m\neq n \\ \frac{L}{2} & m=n \end{cases}$$

$$\begin{matrix} \int_{-L}^L \sin\frac{n\pi}{L}x\sin\frac{m\pi}{L}xdx \\ \int_{-L}^L \cos\frac{n\pi}{L}x\cos\frac{m\pi}{L}xdx \end{matrix} = \begin{cases} 0 & m\neq n \\ L & m=n \end{cases}$$

$$\int_{-L}^L \sin\frac{n\pi}{L}x\cos\frac{m\pi}{L}xdx = 0$$