Fourier Transforms:

A series:

$$f(x) = \sum_{n=-\infty}^{+\infty} c_n e^{\frac{inpx}{L}}$$

Where:

$$c_n = \frac{1}{2L} \int_{-L}^{+L} f(x) e^{-\frac{inpx}{L}} dx$$

Now, if we define: $k = \frac{np}{L}$

$$g(k_n) = \frac{L}{p} c_n$$

$$= \frac{1}{2p} \int_{-L}^{+L} f(x) e^{-\frac{inpx}{L}} dx$$

Hence:

$$\Delta k = p/L \Rightarrow c_n = g(k)\Delta k$$

$$f(x) = \sum_{n=-\infty}^{+\infty} g(k_n) \Delta k e^{-\frac{inpx}{L}}$$

Taking the limit as $\Delta k \to 0$:

$$f(x) = \int_{-\infty}^{+\infty} g(k) e^{-ikx} dk$$

$$g(k) = \frac{1}{2p} \int_{-L}^{+L} f(x) e^{-ikx} dx$$

$g(k)$ is the Fourier Transform of $f(x)$.
$f(x)$ is the inverse Fourier Transform of $g(k)$.