Soln- $f(x) = \frac{a_0}{2} + \sum_{n=1}^{\infty} a_n \cos\frac{n\pi x}{l} + \sum_{n=1}^{\infty} b_n \sin\frac{n\pi x}{l}$

$a_0 = \frac{1}{\pi}\int_0^{2\pi} f(x)\,dx$

$a_0 = \frac{1}{\pi}\int_0^{2\pi} e^{-x}\,dx$

$= \frac{1}{\pi}\left[\frac{e^{-x}}{-1}\right]_0^{2\pi} = \frac{-1}{\pi}\left[e^{-2\pi} - e^{0}\right]$

$= \frac{-1}{\pi}\left[e^{-2\pi} - 1\right]$

$a_0 = \frac{1}{\pi}\left[1 - e^{-2\pi}\right]$

$a_n = \frac{1}{\pi}\int_0^{2\pi} f(x)\cos nx\,dx$

$= \frac{1}{\pi}\int_0^{2\pi} e^{-x}\cos nx\,dx$

$\left[\because \int e^{ax}\cos bx = \frac{e^{ax}}{a^2+b^2}(a\cos bx + b\sin bx)\right]$

$a_n = \frac{1}{\pi}\left[\frac{e^{-x}}{1+n^2}(-\cos nx + n\sin nx)\right]_0^{2\pi}$

$= \frac{1}{\pi(1+n^2)}\left[-e^{-x}(\cos nx - n\sin nx)\right]_0^{2\pi}$

$= \frac{1}{\pi(1+n^2)}\left[-(e^{-2\pi} - 1)\right]$

$a_n = \frac{1 - e^{-2\pi}}{\pi(1+n^2)}$

$b_n = \frac{1}{\pi}\int_0^{2\pi} e^{-x}\sin nx\,dx$

$\left[\because \int e^{ax}\sin bx\,dx = \frac{e^{ax}}{a^2+b^2}(a\sin bx - b\cos bx)\right]$

$= \frac{1}{\pi}\left[\frac{e^{-x}}{1+n^2}(-\sin nx - n\cos nx)\right]_0^{2\pi}$

$= \frac{-n}{\pi}(e^{-2\pi} - 1)$

$b_n = \frac{n}{(1+n^2)\pi}(1 - e^{-2\pi})$

$f(x) = e^{-x} = \left[\frac{1-e^{-2\pi}}{2\pi}\right] + \sum_{n=1}^{\infty}\left(\frac{1-e^{-2\pi}}{\pi}\right)\frac{1}{n^2+1}\cos nx$

$+ \sum_{n=1}^{\infty}\left(\frac{1-e^{-2\pi}}{(n^2+1)\pi}\right) n \sin nx$