Mystery Signal part A

$T = 4$

$A = \frac{1}{2}, c_0 = \frac{A}{T} = \frac{1}{8}$

$c_0 = \frac{1}{8}, d_0 = 0$

$f(0 < t < 1) = t$

For c_k:

$c_k = \frac{2}{4} \int_0^1 t \cos(k\omega_0 t) dt$

$u = t, du = dt$

$dv = \cos(k\omega_0 t) dt, v = \frac{1}{k\omega_0} \sin(k\omega_0 t)$

$uv - \int_0^1 v du = \frac{t}{k\omega_0} \sin(k\omega_0 t) - \int_0^1 \frac{1}{k\omega_0} \sin(k\omega_0 t) dt$

$\frac{t}{k\omega_0} \sin(k\omega_0 t) - \int_0^1 \frac{1}{k\omega_0} \sin(k\omega_0 t) dt$

$c_k = \frac{1}{2} \left(\frac{t}{k\omega_0} \sin(k\omega_0 t) + \frac{1}{(k\omega_0)^2} \cos(k\omega_0 t) \ |_0^1 \right)$

$c_k = \frac{1}{2} \left(\frac{1}{k\omega_0} \sin(k\omega_0) + \frac{1}{(k\omega_0)^2} \cos(k\omega_0) - \frac{1}{(k\omega_0)^2} \right)$

For d_k:

$a = k\omega_0$ to make life easy

$d_k = \frac{2}{4} \int_0^1 t \sin(at) dt$

$d_k = \frac{1}{2} \left(-\frac{t}{a} \cos(at) + \frac{1}{a^2} \sin(at) \right) \ |_0^1$

$d_k = \frac{1}{2} (-\frac{1}{a} \cos(a) + \frac{1}{a^2} \sin(a)$

$d_k = \frac{1}{2} (-\frac{1}{k\omega_0} \cos(k\omega_0) + \frac{1}{(k\omega_0)^2} \sin(k\omega_0)$