

$$\int \underbrace{\sin(n\omega_0 t)}_{u'} \cdot \underbrace{t}_{v} = -\underbrace{\cos(n\omega_0 t)}_u \cdot \underbrace{\frac{t}{n\omega_0}}_{v'} - \int \underbrace{-\cos(n\omega_0 t)}_u \cdot \underbrace{\frac{1}{n\omega_0}}_{v'} dt$$

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

$$\Rightarrow \sin(\omega_0 n t) \cdot \frac{t^2}{n\omega_0} \cdot \left(-\frac{2}{n\omega_0} (-\cos(n\omega_0 t)) \frac{t}{n\omega_0} + \frac{1}{n^2\omega_0^2} \sin(n\omega_0 t) \right)$$

$$\sin(\omega_0 n t) \cdot \frac{t^2}{n\omega_0} \left(+ \frac{2t}{n^2\omega_0^2} \cos(n\omega_0 t) \right) - \frac{2}{n^3\omega_0^3} \sin(n\omega_0 t)$$

$$\frac{\sin(\omega_0 n t) t^2}{n\omega_0} + \frac{2t \cos(n\omega_0 t)}{n^2\omega_0^2} - \frac{2}{n^3\omega_0^3} \sin(n\omega_0 t)$$

$$\Rightarrow \left. \frac{2t \cos(n\omega_0 t)}{n^2\omega_0^2} - \frac{(n^3\omega_0^3 t^2 - 2) \sin(n\omega_0 t)}{n^3\omega_0^3} \right|_0^T$$

$$\Rightarrow \frac{2T \cdot \cos\left(\frac{2\pi}{T} \cdot T \cdot n\right)}{n^2 \left(\frac{2\pi}{T}\right)^2} - \frac{(n^3 \left(\frac{2\pi}{T}\right)^3 T^2 - 2) \sin\left(\frac{2\pi}{T} \cdot T \cdot n\right)}{n^3 \left(\frac{2\pi}{T}\right)^3}$$

$$\Rightarrow \frac{2T \cdot \cos(2\pi n)}{\frac{4\pi^2 n^2}{T^2}} - \frac{\left(\frac{8\pi^3 n^3}{T^3} T^2 - 2\right) \cdot \sin(2\pi n)}{\frac{8\pi^3 n^3}{T^3}}$$

$$\Rightarrow 2T \cdot \cos(2\pi n) \cdot \frac{T^2}{4\pi^2 n^2} - \frac{8\pi^3 n^3}{T} \cdot \sin(2\pi n) \cdot \frac{T^3}{8\pi^3 n^3} + 2 \sin(2\pi n) \cdot \frac{T^3}{8\pi^3 n^3}$$