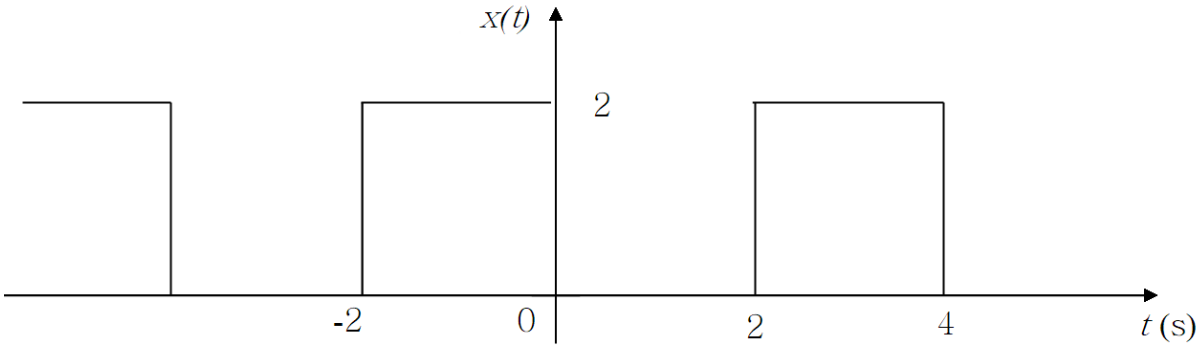
2020年 신호처리 과제 7 답안

1. 다음의 주기 신호의 Fourier coefficient를 구하고, 스펙트럼을 그리시오. ·



$$x(t) = \begin{cases} 0 & 0 \le t \le \frac{1}{2}T_0 \\ 2 & \frac{1}{2}T_0 \le T \le T_0 \end{cases}$$

$for\ T_0 = 4\ \text{sec and}\ f_0 = 0.25.$

$$a_k = \frac{1}{T_0}\int_0^{T_0} x(t)e^{-j(2\pi/T_0)kt}\,dt = \frac{1}{T_0}\int_0^{T_0} x(t)e^{-j2\pi(kf_0)t}\,dt \ (\mathrm{k} \neq 0)$$

$$a_k = \frac{1}{4}\int_2^4 2\cdot e^{-j2\pi\left(\frac{2\pi}{4}\right)t}\,dt = \frac{1}{4}\int_0^4 2\cdot e^{-j2\pi(k\cdot 0.25)t}\,dt$$

$$= \frac{2}{4(-j0.5\pi k)}\cdot e^{-j0.5\pi kt}\Big|_2^4 = \frac{2}{-j2\pi k}\left(e^{-j2\pi k} - e^{-j\pi k}\right)$$

$$= \frac{1^k-(-1)^k}{-j\pi k} = \frac{(-1)^k-1^k}{j\pi k}$$

$$a_0 = \frac{1}{T_0}\int_0^{T_0} x(t)dt = \frac{1}{T_0}(Area)$$

$$a_0 = \frac{1}{4}\int_2^4 2dt = \frac{1}{4}\int_2^4 (8-4) = 1$$

$$a_k = \frac{(-1)^k - 1^k}{j\pi k} = \begin{cases} \frac{2}{\pi|k|} e^{\pm j\frac{\pi}{2}} & k = \pm 1, \pm 3, \dots \\ 0 & k = \pm 2, \pm 4, \dots \\ 1 & k = 0 \end{cases}$$