# ECS 332: In-Class Exercise # 10.2

## Instructions

1. Separate into groups of no more than three persons. **The group cannot be the same as any of your former groups after the midterm.**
2. **Explanation is not required for this exercise.**
3. **Do not panic.**

| Date: 17 / 10 / 2018 | | | |
|---|---|---|---|
| Name | ID (last 3 digits) | | |
| Prapun | 5 | 5 | 5 |
| | | | |
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1. In the previous exercise, we found that, using Fourier series expansion, the rectangular pulse train $r(t)$ shown in Figure 1 can be written in the form

$$\cdots\frac{-1}{3\pi}e^{j2\pi(-3f_0)t}+0e^{j2\pi(-2f_0)t}+\frac{1}{\pi}e^{j2\pi(-f_0)t}+\frac{1}{2}+\frac{1}{\pi}e^{j2\pi(f_0)t}+0e^{j2\pi(2f_0)t}+\frac{-1}{3\pi}e^{j2\pi(3f_0)t}+\cdots$$

where $f_0=\frac{1}{T_0}$.

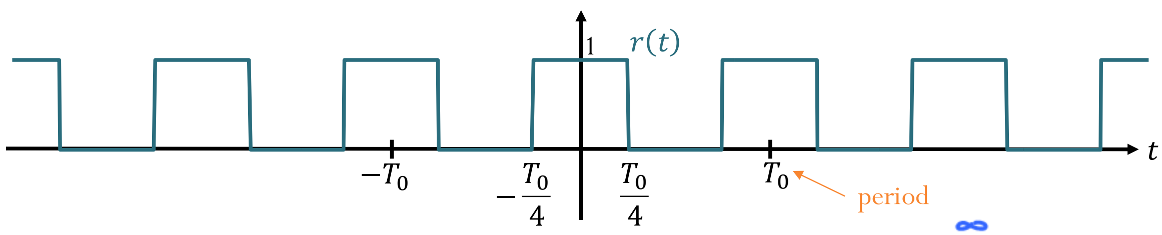


Figure 1

$r(t) = c_0 + \sum_{k=1}^{\infty} a_k \cos(2\pi(kf_0)t)$

Using another form of Fourier series expansion, we can write $r(t)$ in the form

$$\underbrace{\boxed{\tfrac{1}{2}}}_{c_0}+\underbrace{\boxed{\tfrac{2}{\pi}}}_{a_1}\cos(2\pi(f_0)t)+\underbrace{\boxed{0}}_{a_2}\cos(2\pi(2f_0)t)+\underbrace{\boxed{\tfrac{-2}{3\pi}}}_{a_3}\cos(2\pi(3f_0)t)+\underbrace{\boxed{0}}_{a_4}\cos(2\pi(4f_0)t)+\cdots$$

Write the appropriate values of the constants in the boxes above.

2. In the previous exercise, we found that the rectangular pulse train shown in Figure 2 can be constarcted from $r(t)$ in Figure 1 by the relationship

$y(t) = \alpha + \beta r(t - \gamma T_0) = (\alpha + \beta c_0) + \sum_{k=1}^{\infty} \beta a_k \cos\left(\underbrace{2\pi(kf_0)\left(t - \frac{T_0}{4}\right)}\right)$

$$y(t)=-1+2r\left(t-\frac{T_0}{4}\right).$$

$= 2\pi(kf_0)t - \cancel{2}\pi k \cancel{f_0} \frac{\cancel{T_0}}{\cancel{4}_{2}}$

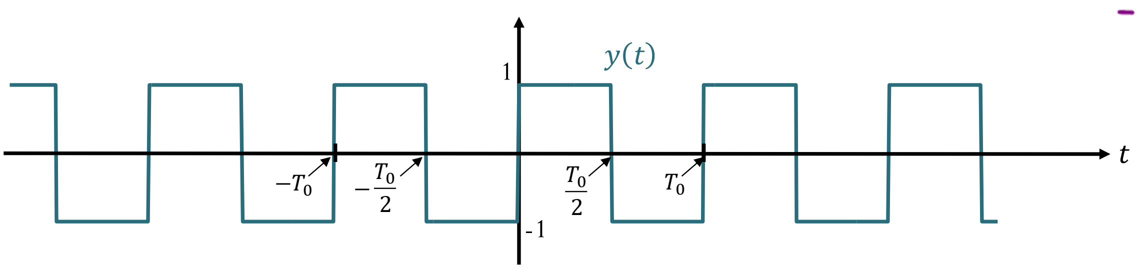


Figure 2

$y(t)$ can be written in the form

$$\boxed{0}+\underbrace{\boxed{\tfrac{4}{\pi}}\sin(2\pi(f_0)t)}+\boxed{0}\sin(2\pi(2f_0)t)+\boxed{\tfrac{4}{3\pi}}\sin(2\pi(3f_0)t)+\boxed{0}\sin(2\pi(4f_0)t)+\cdots.$$

$\alpha + \beta c_0$
$= -1 + 2 \times \frac{1}{2}$

Write the appropriate values of the constants in the boxes above.

$= \beta a_1 \cos\left(2\pi f_0 t - \frac{\pi}{2}\right)$
$= 2 \times \frac{2}{\pi} \times \sin(2\pi f_0 t)$

$= \beta a_3 \cos\left(2\pi(3f_0)t - 3\frac{\pi}{2}\right)$
$= 2 \times \left(\frac{-2}{3\pi}\right)\left(-\sin(2\pi(3f_0)t)\right)$