Name: ______________________ RIN: ______________________

Rensselaer Polytechnic Institute
Department of Electrical, Computer, and Systems Engineering
ECSE 2410: Signal and Systems, Fall 2020

Exam #2. Session 1
November 13, 2020, 10:10-11:30 AM

Show all work for full credit.

- Open book, open notes. Calculators allowed.
- Computers, iPads, and similar devices for viewing notes only.
- No typing or writing on computers, iPads or similar devices.
- Cameras on, mic off. Announcements will be sent through Webex chat.
- If any doubt or question, send a PRIVATE message through Webex to the instructor or TAs.
- Because there are multiple versions of the exam, each of you only gets partial exam problems. To double check, your exam should contain the following problems. if not correct, please contact the instructor.

  Problems 1, 2, 3, 5, 7, 8
- When in doubt, show more work!

Please write down the following statement

"I have not witnessed any wrongdoing, nor have I personally violated any conditions of the Honor Code, while taking this examination."

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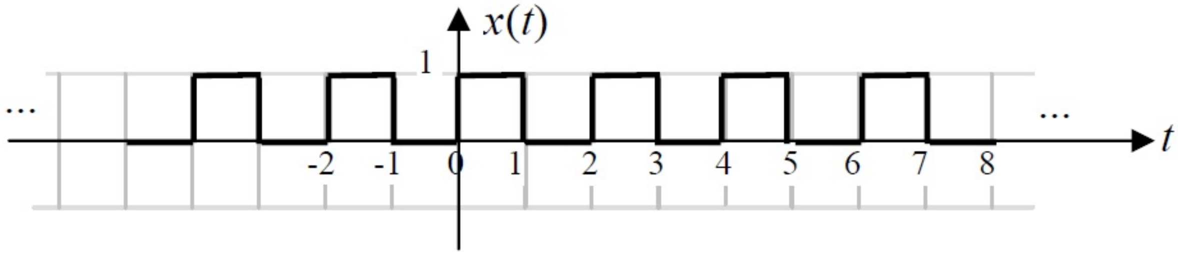
Signature: ______________________ Date: ______________________

1 (8 points.) The Fourier Series coefficients the periodic signal $x(t)$ are denoted by a_k, where k is an integer. Find a_0.

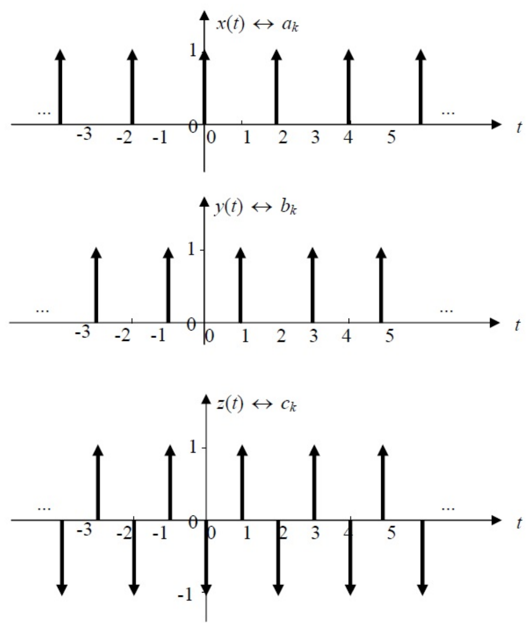


2 (18 points.) $x(t)$, $y(t)$, and $z(t)$ shown below are all periodic signals.

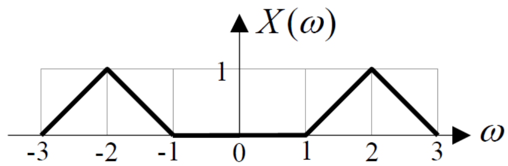
(a) Find the Fourier Series coefficients, denoted by a_k, for $x(t)$.

(b) Find the Fourier Series coefficients, denoted by b_k, for $y(t)$.

(c) Find the Fourier series coefficients, denoted by c_k, for $z(t)$.



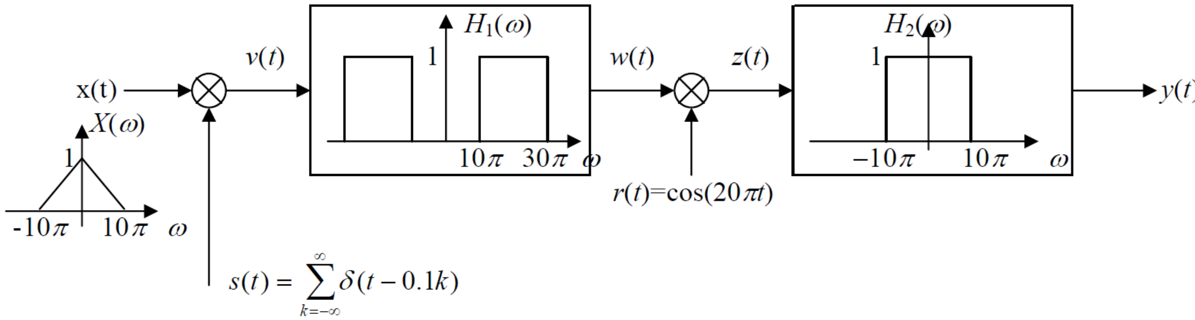
3 (16 points.) Find and sketch the Fourier transform of $y(t) = x(t)\cos(2t)$, where the Fourier Transform of $X(\omega)$ is shown below.



5 (16 points.) Use properties to find the Inverse Fourier Transform $x(t)$ of

$$X(\omega) = j\frac{d}{d\omega}\left(\frac{e^{j3\omega}}{1 + j\omega}\right).$$

7 (26 points.) For the following diagram, sketch the Fourier Transforms of signals $v(t)$, $w(t)$, $z(t)$ and $y(t)$.



8 (16 points.) Consider the signal $x(t) = 2\cos(2\pi t) + \cos(3\pi t) + \cos(4\pi t)$.

(a) (8 points.) what is the Nyquist sampling rate, ω_s, of this signal to guarantee perfect reconstruction of $x(t)$ from its uniformly spaced samples?

(b) (8 points.) Suppose the signal $x(t)$ is modulated by a carrier signal $c(t) = \cos(2000\pi t)$, so that the resulting signal is $y(t) = x(t)c(t)$. What is the highest frequency in $y(t)$?

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