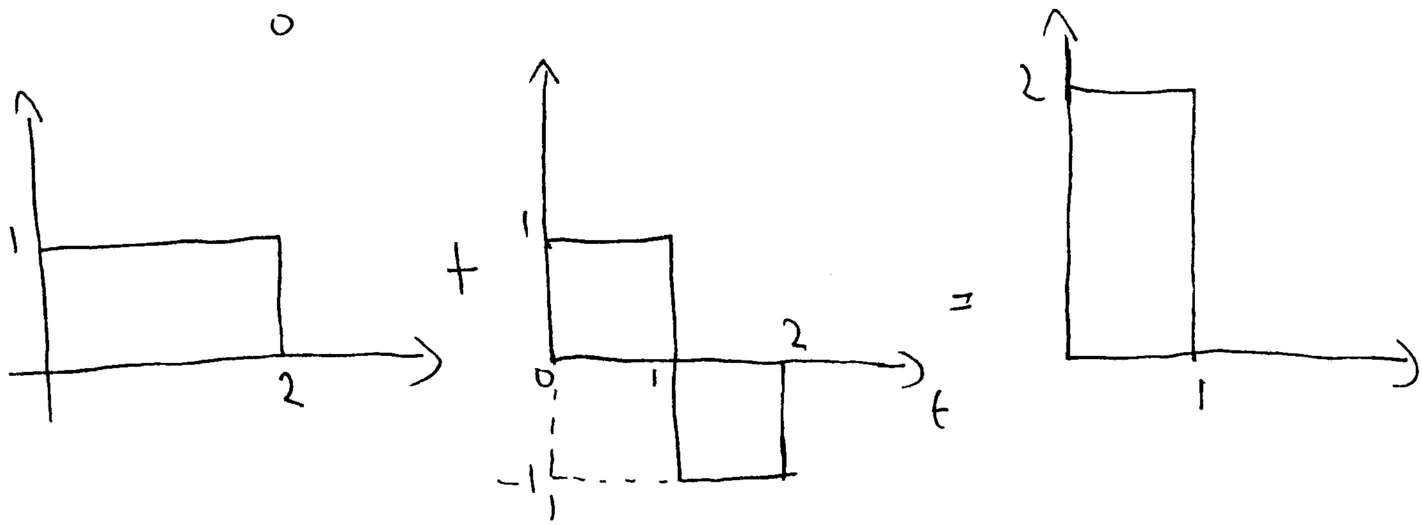
COMMUNICATIONS I

SOLUTIONS TO PROBLEM SHEET TWO

1) $$E_x = \int_0^2 (1)^2 dt = 2$$

$$E_y = \int_0^1 (1)^2 dt + \int_1^2 (-1)^2 dt = 2$$

$$c_{xy} = \frac{1}{2}\int_0^2 x(t) \cdot y(t) dt = 0$$



$$E_{x+y} = \int_0^1 (2)^2 dt = 4$$

$E_{x+y} = E_x + E_y$, BECAUSE SIGNALS ARE ORTHOGONAL

2) SIGNAL ENERGIES

$E_x = 2$, $E_y = 2$

CORRELATION COEFFICIENT

$$C_{xy} = \frac{1}{2}\int_0^2 x(t)\cdot y(t)\,dt = \frac{1}{2}\int_0^2 x(t)\,y(t)\,dt = \frac{1}{2}\left[\int_0^{0.5}(1)\,dt - \int_{0.5}^{2}(1)\,dt\right] = -\frac{1}{2}$$

ENERGY OF $z(t) = x(t) + y(t)$

$$E_{x+y} = \int_0^{0.5}(2)^2\,dt = 2$$

$E_{x+y} \neq E_x + E_y$ THIS IS BECAUSE SIGNALS ARE NOT ORTHOGONAL.

IN GENERAL,

$$E_{x+y} = E_x + E_y + 2\,C_{xy}\cdot\sqrt{E_x \cdot E_y}$$

4) $T_0 = 4$, $\omega_0 = \pi/2$

BY INSPECTION $a_0 = 0$

$b_n = 0$ FOR ALL n SINCE THE FUNCTION IS EVEN

$$a_n = \int_0^1 \cos\left(\frac{n\pi}{2} t\right) dt - \int_1^2 \cos\left(\frac{n\pi}{2} t\right) dt = \frac{4}{n\pi} \sin \frac{n\pi}{2}$$