Exam 3

Problem 1

(a): 2

(b): even

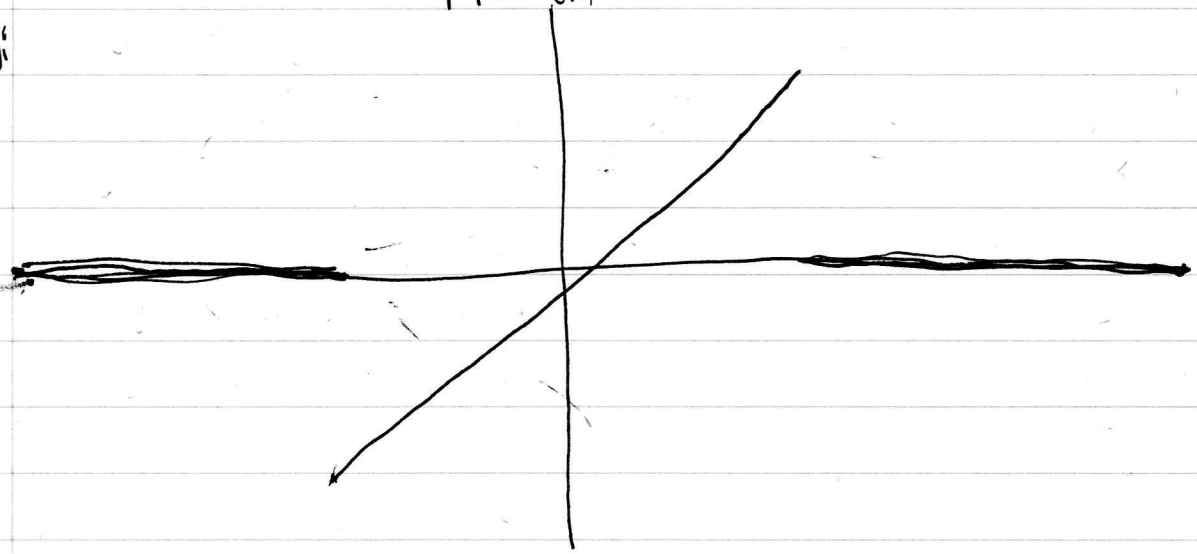
(c): The particular solution is

$$x_p(t) = \frac{1}{w_n^2} + \frac{\cos(\pi t)}{2(w_n^2 - \pi^2)} + \frac{\cos(2\pi t)}{4(w_n^2 - 4\pi^2)} + \text{etc.}$$

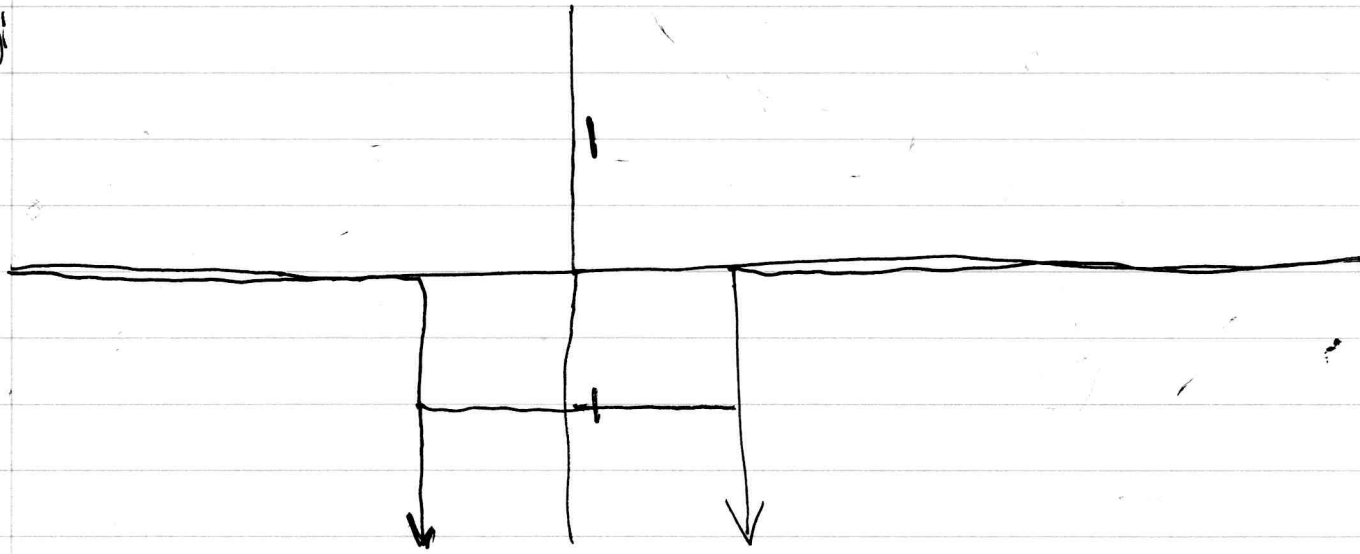
(d): By looking at (c), any integer multiple of π.

Problem 2

(a)



(b)



(c) The generalized derivative is

$$f'(t) = (u(t+1) - u(t-1)) - \delta(t+1) - \delta(t-1)$$

Problem 3

(a): We have that

$$\int_0^t e^{-(t-\tau)} - e^{-3(t-\tau)}\, d\tau = e^{-t} e^{-\tau} \Big|_0^t - \frac{e^{-3t} e^{3\tau}}{3} \Big|_0^t$$

$$= \frac{2}{3} - e^{-t} + \frac{e^{-3t}}{3}$$

(b): $W(s) = \frac{1}{s+1} - \frac{1}{s+3}$

(c): $\frac{2}{s^2+4s+3}$

Problem 4

(a): We have

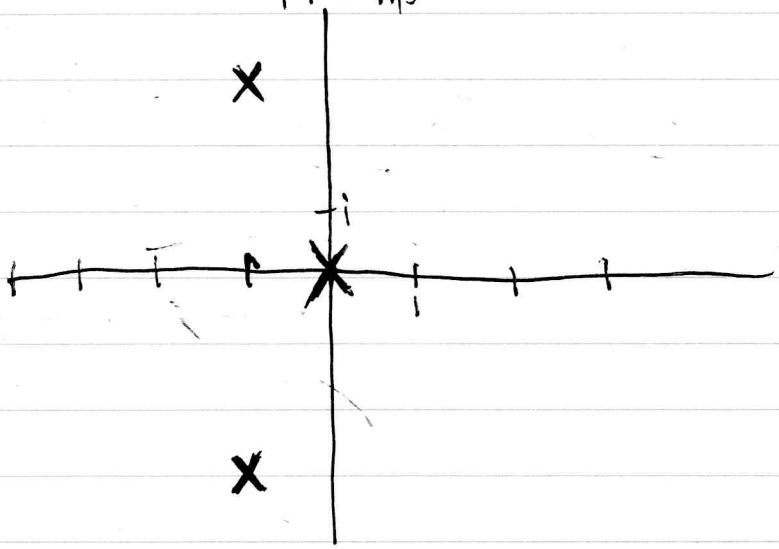
$\frac{e^{-s}(s-1)}{s} = e^{-s} - \frac{e^{-s}}{s}$, thus we invert to get

$\delta(t-1) - u(t-1)$

(b): $f(s) = \frac{1}{s} - e^{-t}\cos(3t)$

Problem 5

(a):



(b): $\left(\frac{s+10}{s^3+2s^2+10s}\right)\left(\frac{2}{s^2+4}\right)$