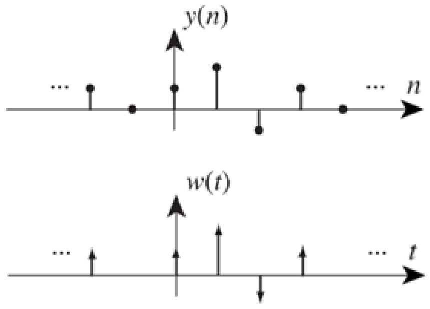
2018W2 MT2, Q1c

For the “sampled signals” *y* and *w* used during sampling and reconstruction, as shown, explain how they differ mathematically (at least two points) and write the equation relating them to each other.



2018W2 MT2, Q1d

For signals $x(t) = \begin{cases} \cos(t), & 0 \le t \le 1 \\ 0 & \text{otherwise} \end{cases}$ and $y(t) = x\left(\frac{t}{2}\right)$, find their Fourier Transforms $X(\omega)$ and $Y(\omega)$.

2018W2 MT2, Q1e (cf WW4,Q4)

Consider an ideal low pass filter with the following frequency response:

$$|H(j\omega)| = \begin{cases} 1, & -4 \le \omega \le 4 \\ 0, & \text{otherwise} \end{cases} \qquad \angle H(j\omega) = \begin{cases} -\pi/2, & \omega \ge 0 \\ \pi/2, & \omega < 0 \end{cases}$$

Determine the impulse response $h(t)$ and the output for $x(t) = \sum_{k=1}^{\infty} \frac{2}{\mathrm{k}^2} \cos(3kt/2)$.

2018W2 MT2, Q1e (cont.)

2018W2 MT2, Q2

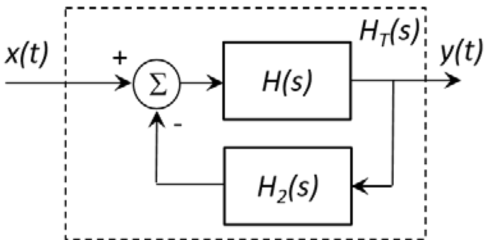
A (causal) continuous time LTI system is represented by the ODE $\frac{dy(t)}{dt} = -y(t) + x(t)$ where $x(t)$ is the input and $y(t)$ the output.

a) Determine the system frequency response $H(j\omega)$ and impulse response $h(t)$.

b) For input $x(t) = \frac{\sin(t)}{\pi t}$, determine the Fourier transform of the output $Y(\omega)$ and sketch a plot of $|Y(\omega)|$ vs ω (use a linear scale as this is not a Bode plot).

2018W2 MT2, Q2 (cont.)

c) If a feedback system with transfer function $H_2(s) = \frac{s}{s+2}$ is implemented as shown, determine the net transfer function $H_T(s)$.



2018W2 MT2, Q3

Consider $x(t) = \cos(50\pi t + \frac{\pi}{11})$, $y(t) = \cos(300\pi t - \frac{\pi}{11})$, and $z(t) = 3\sin(200\pi t - \frac{\pi}{11})$.

a) If sampled at $f_s = 400\ Hz$, state whether the following signals are periodic or aperiodic, and if so, determine their period:
   - $p[n] = y(nT_s) + z(nT_s)$
   - $q[n] = y(nT_s)x(nT_s)$

2018W2 MT2, Q3 (cont.)

b) Compute the Nyquist sampling rate of the signal $u(t) = y(t)\cos(50\pi t)$.

c) For the continuous time signal $v(t) = x(t) - y(t) + z(t)$, determine the discrete time signal $v_s[n] = v(nT_s)$ using a sampling rate of $f_s = 180\ Hz$.

2018W2 MT2, Q3 (cont.)

d) From the discrete time signal $v_s[n]$ found in Part (c), determine the reconstructed signal using an ideal interpolator and a sampling interval of $T_s = \frac{1}{180}$ seconds. Indicate which, if any, frequencies have been aliased.

WW4, Q7

Let $x(t)$ be a periodic signal of fundamental frequency $\omega_0 = \frac{2\pi}{T_0}$ that has Fourier series coefficients, X_k. For each of the signals $y(t)$ given in the table below, first determine if they are periodic or not. Then, for the periodic signals, determine their period in terms of T_0, and calculate their Fourier coefficients Y_0 and Y_k in terms of X_0 and X_k, the corresponding Fourier coefficients of $x(t)$.

In your answers, enter “Xk” for X_k and “X0” for X_0, “w” for ω_0, and “T” for T_0. Enter “NA” for the aperiodic signals.

Signal, $y(t)$	Periodic/Aperiodic	Period	Y_0	Y_k
$4x(t) - 4$	?			
$x(\pi t) + 2x(t-8))$	?			
$x(t-3) + 3x(t)$	?			

WW5, Q3

The transfer function of a filter is $H(s) = \dfrac{\sqrt{45}\,s}{s^2 + (2\sqrt{11})s + 12}$.

a) Find the poles, s_1 and s_2, and the zero, s_0, of the system.

$s_{1,2} =$ [ ]

$s_0 =$ [ ]

Enter the poles as a list, seperated by commas

b) Find the magnetude and phase (in degrees) of the frequency response at each of the frequencies given in the table below:

ω	$\lvert H(\omega)\rvert$	$\angle H(\omega)$ (degrees)
0		
1		
∞		

c) What type of filter is this? ?

d) Find the impulse response, $h(t)$, of the filter.

$h(t) =$ [ ]

e) This filter is connected in series with a sinusoidal signal generator which generates biased sinusoids $x(t) = B + Acos(\omega t)$ as the input to the filter. Find the frequency (or frequencies) ω_0 where the filter's output is $y(t) = Acos(\omega_0 t + \theta)$, i.e, the amplitude of the sinusoid remains the same. If there are multiple frequencies where this occurs, enter the positive frequencies only as a list, separated by commas in decreasing order.

$\omega_0 =$ [ ] rad/s

Correct Answer
$-3.31662 - i, -3.31662 + i$
0
0
0
0.522233
58.9091
0
0
Band-pass
$6.7082e^{-3.31662t}(\cos(t) - 3.31662\sin(t))\,u(t)$
$3, 4$