Problem 1

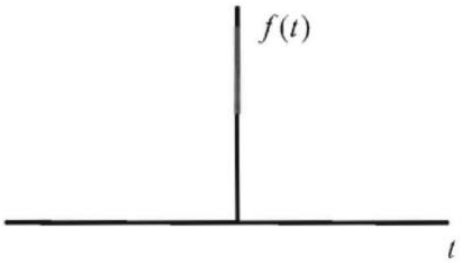
a) The signal y(t) = f(t) · g(t). If f(t) has a bandwidth W_1 rad/s and g(t) has a bandwidth W_2 rad/s, what is the bandwidth of y(t)?

BW = _____

Problem 2

a) Consider the function $f(t) = e^{t}u(1-t)$.

i) Sketch $f(t)$.



ii) Find the Fourier transform $F(\omega)$ of $f(t)$.

$F(\omega)$ = _____

b) Consider the convolution $y(t) = Sinc(2t) * Sinc(5t)$.

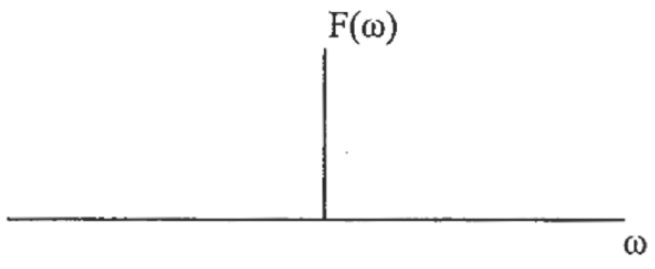
i) Find $y(t)$.

$y(t)$ = _____

ii) Specify the complete set of times t when $y(t) = 0$.

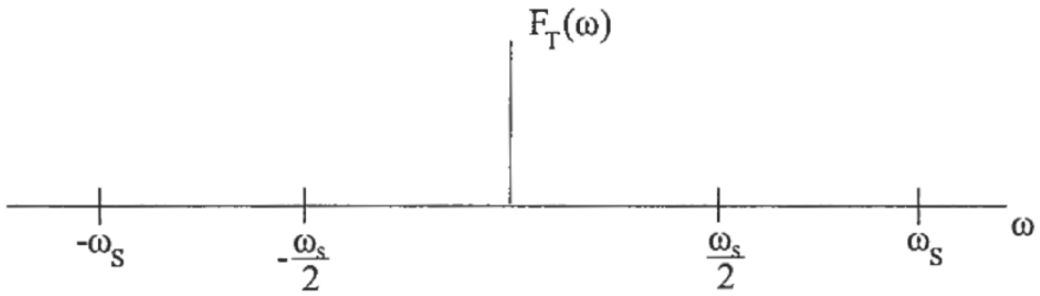
Problem 3

a) Given $f(t) = 3\cos 5t + 4\cos 8t$, find and plot $F(\omega)$. Clearly label axes.

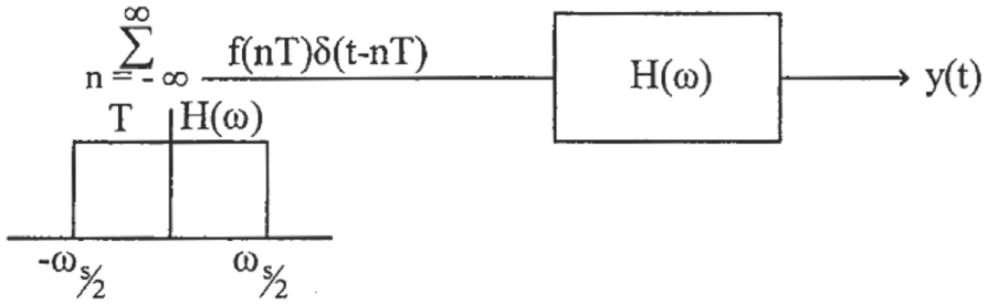


$F(\omega) =$ _____

b) $f(t)$ is sampled at a sampling rate of $\omega_S = 12$ rad/s. Plot the frequency spectrum $F_T(\omega)$ of the sampled signal for $-\omega_S \le \omega \le \omega_S$. Clearly label all values.



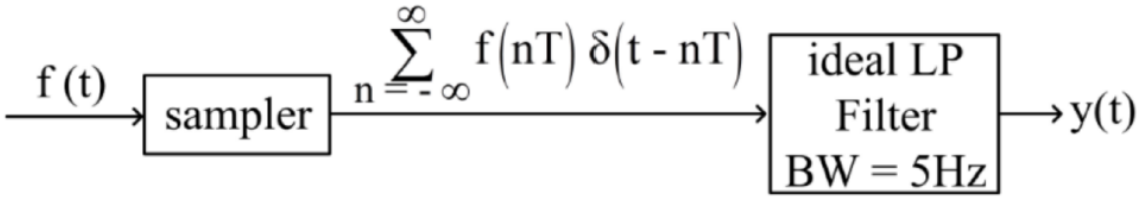
c) An analog signal is reconstructed from the above samples as shown below. What is the output $y(t)$.



$y(t) =$ _____

Problem 4 *(25 points)*

(a) *(10 pts)* The signal $f(t) = 4\cos 2\pi \bullet 3t + 2\cos 2\pi \bullet 8t$ is sampled producing the output $\sum_{n=-\infty}^{\infty} f(nT)\,\delta(t - nT)$ where T = 0.1 second. Next the sampled signal is passed through an ideal LP filter with unity gain and a BW = 5Hz. See diagram below.



(i) Sketch $F(2\pi f)$ for $-10\text{Hz} \le f \le 10\text{Hz}$.

(ii) Repeat Part (a) for the frequency spectrum $F_T(2\pi f)$ of the sampled signal.

(iii) The output $y(t) =$ _____

(b) *(5 pts)* The step response of a LTI system is $g(t) = \left[3te^{-2t} + e^{-2t}\right]u(t)$ and its impulse response is $h(t) =$ _____

(c) *(5 pts)* Given the impulse response $h(t) = \left(e^{-t} - te^{-t}\right)u(t)$ find $H(\omega)$. Use the table provided. Simply and classify $|H(\omega)|$ as

LP BP HP (circle the correct answer)

$|H(\omega)| =$ _____