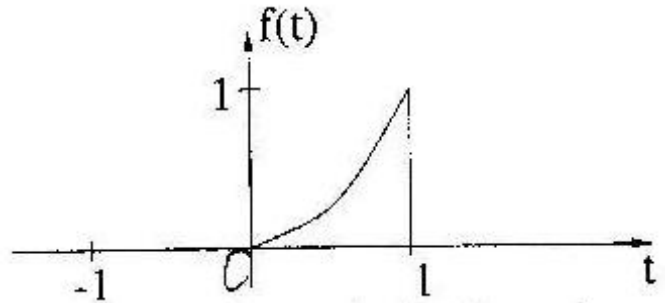


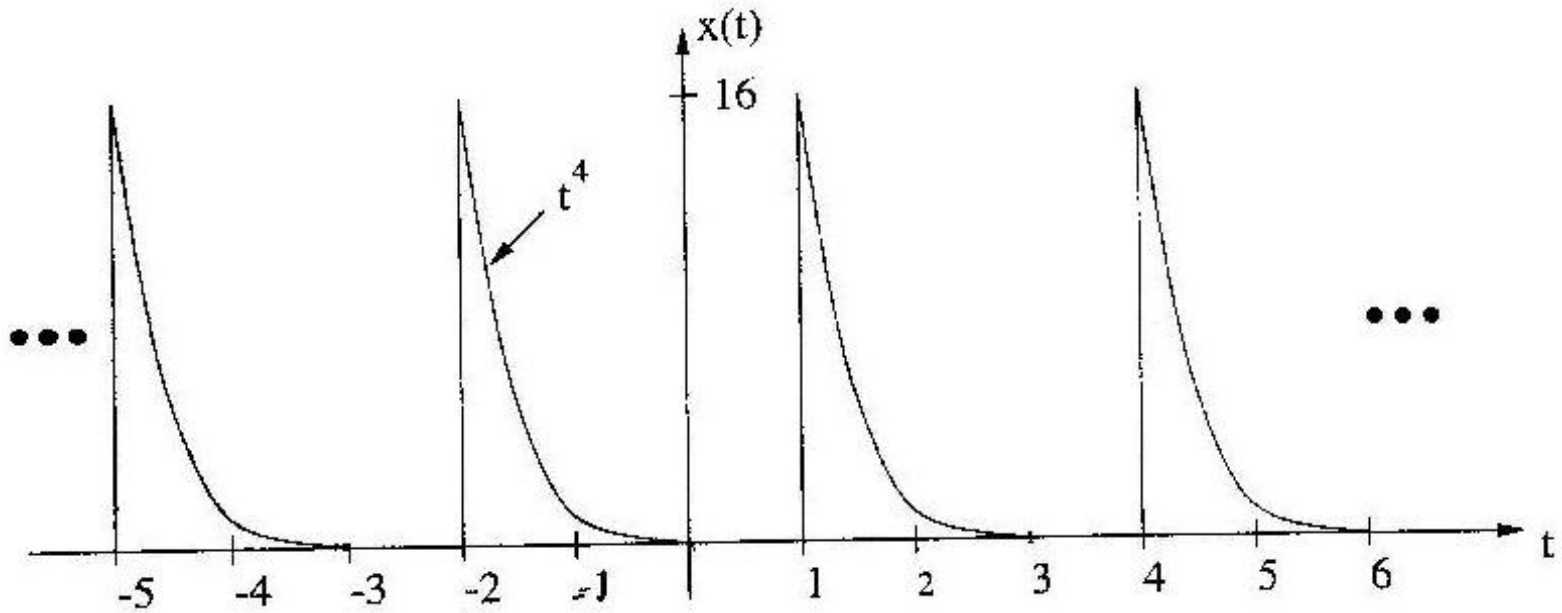
**EE 120, Spring 1998
Midterm #2
Professor Lau**

Problem #1

Consider the function $f(t) = \begin{cases} t^4 & 0 < t < 1 \\ 0 & \text{otherwise} \end{cases}$



Suppose you are told what $F(\omega) = \mathcal{F}\{f(t)\}$ is. Now consider the periodic function $x(t)$:

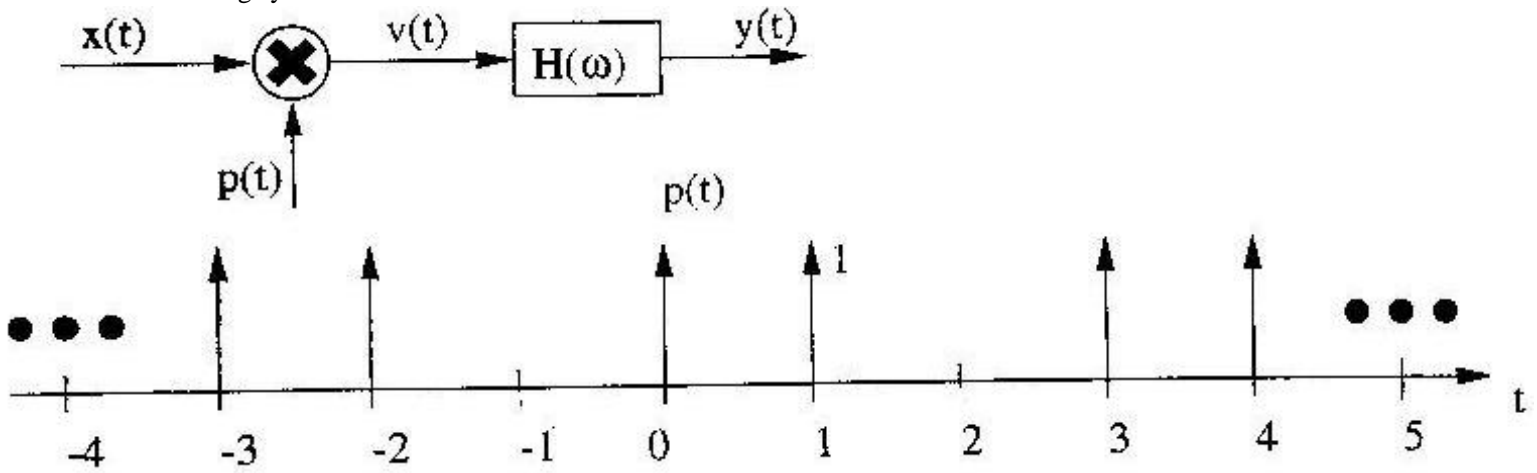


The Fourier series expansion of $x(t)$ is $x(t) = \sum_{k=-\infty}^{\infty} a_k e^{jk\omega_0 t}$

- (a) What is ω_0 ?
- (b) Find A_k in terms of $F(\omega)$.
- (c) Find $\sum_{k=-\infty}^{\infty} |a_k|^2$. (Find the actual numerical value.)

Problem #2

Consider the following system:



where $x(t)$ is bandlimited; i.e., $X(\omega) = 0$ for $|\omega| > B$.

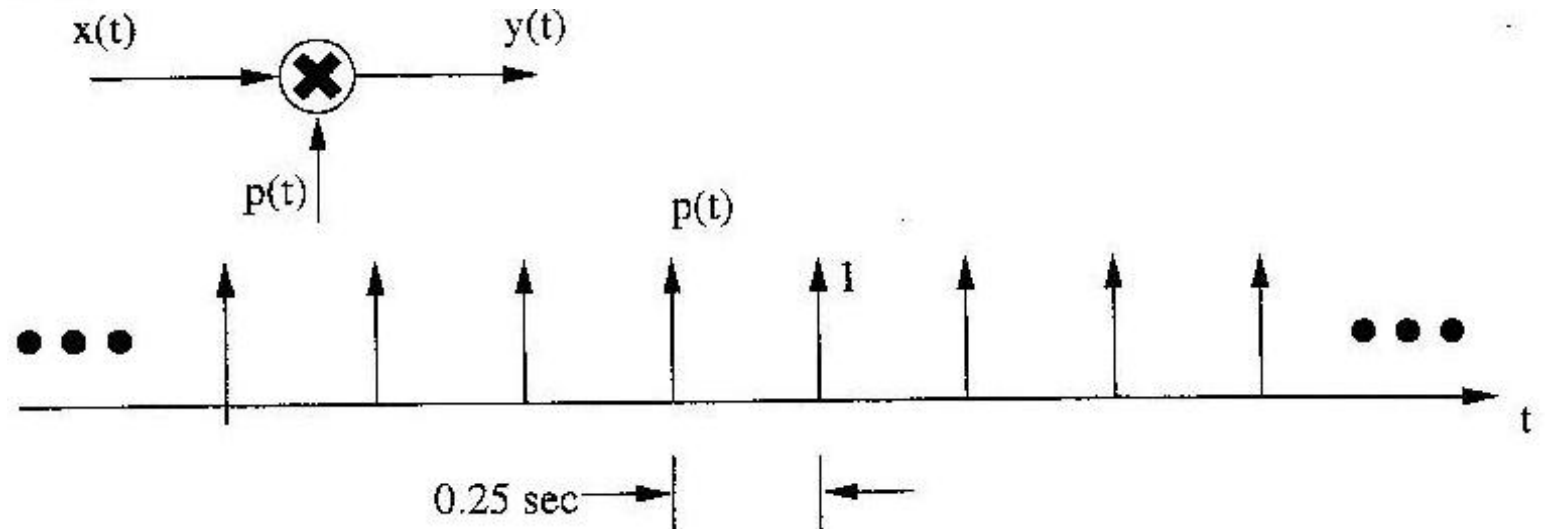
- Find $P(\omega) = \mathcal{F}\{p(t)\}$. Sketch $|P(\omega)|$.
- What is the maximum value of B for which we can recover the original signal $x(t)$ from the sampled signal $v(t)$?
- If the constraint in part (b) is satisfied, sketch $|H(\omega)|$ to recover $x(t)$.

Problem #3

Consider a sine wave of frequency 5 Hz, $x(t) = \cos(10\pi t)$, that is sampled by a comb of frequency 4 Hz, $p(t) =$

$$\sum_{k=-\infty}^{\infty} \delta(t - \frac{1}{4}k),$$

to yield the signal $y(t)$:



- Sketch the spectrum (Fourier Transform) of the sampled signal $y(t)$.
- Is $y(t)$ periodic? If so, what is its period? (Careful!)

Problem #4

Find the values of τ and A which satisfy the following:

$$\Pi(t - \tau) * \sin t = A \cos\left(t + \frac{\pi}{4}\right)$$

where

$$\Pi(t) = \begin{cases} 1 & -\frac{1}{2} \leq t \leq \frac{1}{2} \\ 0 & \text{otherwise} \end{cases}$$

Numerical values are not required; you may leave the result as an expression involving constants.

Posted by HKN (Electrical Engineering and Computer Science Honor Society)

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**If you have any questions about these online exams
please contact <mailto:examfile@hkn.eecs.berkeley.edu>**