26.06.2007

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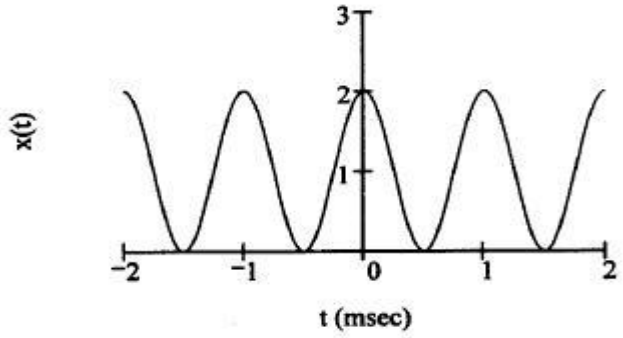
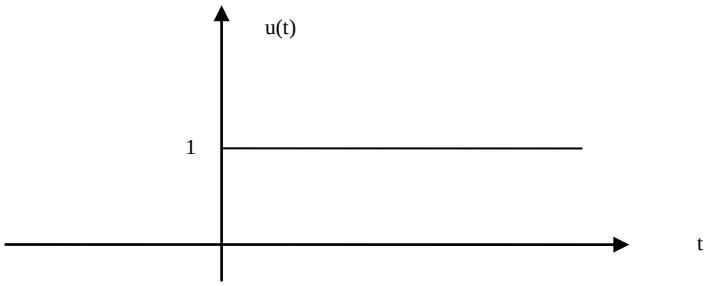
**EE 224 Year Exam**

**Q1) (25pts)** Express the sinusoidal signal shown to below as a Fourier series in complex exponential form.




**Q2) (15pts)** Find the Fourier transform of the unit step function, u(t).




**Q3) (10pts)** The Fourier transform a linear operation; that is, for any function f(x) and g(x) whose Fourier transforms exist and any constant a and b, F[af(x)+bg(x)]=aF[f(x)]+b[g(x)]. Prove it.

**Q4) (25pts)** Consider a discrete-time LTI system with impulse response $h[n] = e^{j\omega_c n}$. What will be the output of system $y[n]$ to the given input $x[n] = \delta(n)$ in frequency domain? Plot input, impulse response and output in frequency domain.

| Time Domain x[n] | Frequency Domain X(ω) |
|---|---|
| $\delta[n]$ | 1 |
| $u[n]$ | $\frac{1}{1-e^{-j\omega}}$ |
| $e^{jn}$ | $2\pi\,\delta(\omega)$ |
| $\frac{\sin(n\omega_0)}{\pi n}$<br>$0 < \omega_0 < \pi$ | $\begin{cases} 1 & 0 \le \lvert\omega\rvert \le \omega_0 \\ 0 & \omega_0 < \lvert\omega\rvert \le \pi \end{cases}$ |

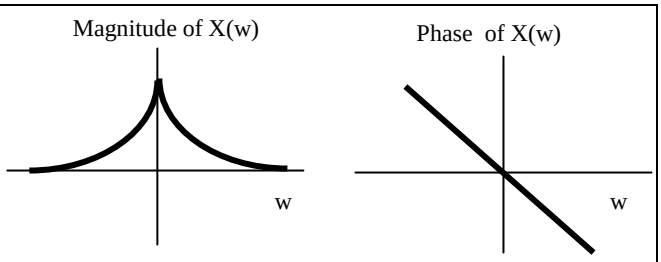
**Q5. (10pts)** The time-sequence which have the magnitude and phase of the frequency domain waveform given in the left figure,

a) is periodic? Why?

b) has finite energy? Why?

c) is real? Why?

d) has even symmetry? Why?




**Q6. (15pts)** a) Why frequency analysis is used? What is the advantage?

b) What is FFT? Why it is used?

c) Why the number of data should the power of 2 for using FFT?