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Thapar Institute of Engineering & Technology, Patiala, Punjab, India

Department of Electronics and Communication Engineering

B.E.-ECE & ENC (Second Year)	Course Code: UEC404
Semester-III; Mid Semester Examination	Course Name: Signals and Systems
September 28th, 2018	Friday; 10:30 A.M. – 12:30 P.M.
Time: 2 Hours, Max. Marks: 30	Name of Instructors:- Dr. Kulbir Singh (Prof.) Dr. Amit K. Kohli, Dr. S.K. Patel & Dr. B. Garg

Note: Strictly attempt all questions sequentially & Assume missing data, if any, suitably

Q.1(a) Comment about the periodicity of following signals (02)

i). $x(n)=\cos(n/6)$ in discrete-time **ii).** $x(t)=\cos(t/6)$ in continuous-time

Determine the fundamental periods also.

Q.1(b) Whether the following systems are with or without memory? (Justify it). (02)

i). $y[n]=\sum_{k=-\infty}^{n} x[k]$ **ii).** $y(t)=(1/C)\int_{-\infty}^{t} x(\tau)d\tau$

Q.1(c) Consider a continuous-time system defined by $y(t)=\sin\{x(t)\}$. (02)

Check it for linearity and time-invariance using the standard procedure.

Q.1(d) If the impulse response of an underlying system is $h(t)=u(t)$ (unit-step function), then what about its stability? Provide details. (02)

Q.2(a) Establish relation between the Laplace-transform and continuous-time Fourier-transform. Give its graphical interpretation using the appropriate mathematical expressions. (03)

Q.2(b) Use the periodic impulse train $p(t)=\sum_{n=-\infty}^{+\infty}\delta(t-nT)$ (sampling function) to sample the continuous-time signal $x(t)$, when the baseband spectrum of $x(t)$ is as shown in Figure 1. (04)

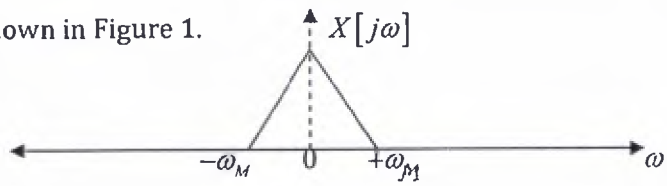

Figure 1.

Derive the mathematical expression for the sampled signal $X_p[j\omega]$ in frequency-domain, and also plot it to determine the Nyquist rate.

What should be the frequency-domain impulse response of low-pass-filter (LPF) $H[j\omega]$, that can be used to reconstruct the signal $X_r[j\omega]$ (i.e., approximate replica of $X[j\omega]$)? Plot $X_p[j\omega]$, $H[j\omega]$ and $X_r[j\omega]$ vs. ω.

Q.3(a) Let the input to a discrete-time LTI system be $x[n]$, whose impulse response is $h[n]$. Obtain output $y[n]$ of the underlying LTI system, when $x[n] = [\underset{\uparrow}{+1}, -1, +1, -1]$ and $h[n] = [\underset{\uparrow}{+1}, +2, +2, +1]$. (04)

Q.3(b) Establish relation between the Z-transform and discrete-time Fourier-transform. Give its graphical interpretation using the appropriate mathematical expressions. (03)

Q.4(a) Plot the signaling waveforms $x(2t)$ and $x(2t-4)$, if the basic signal $x(t)$ is as shown in Figure 2. (02)

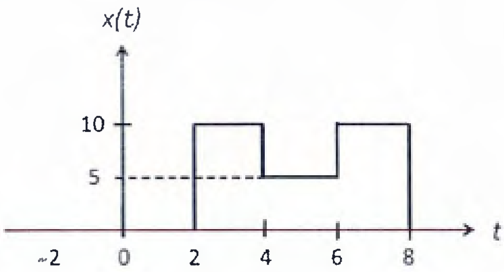

Figure 2.

Q.4(b) Let the continuous-time periodic signal (with fundamental frequency ω_o) under observation be $x(t) = 1 + \sin(\omega_o t) + 2\cos(\omega_o t)$. Express it in terms of the continuous-time Fourier-series using the spectral coefficient/Fourier-series coefficients a_k. Plot $|a_k|$ (magnitude) vs. k. (03)

Whether $a_k = a_{k+T}$ with the fundamental period T?

Q.4(c) Let the discrete-time impulse response of an LTI system is represented as $h[n] = (1/3)[\delta[n+1] + \delta[n] + \delta[n-1]]$, where $\delta[n]$ is the unit-impulse function. (03)

Calculate its discrete-time Fourier-transform $H[e^{j\omega}]$ for the frequency-domain analysis. Plot the magnitude spectrum $|H[e^{j\omega}]|$ vs. ω.