USN

Fifth Semester B.E. Degree Examination, Dec.09/Jan.10

Signals and Systems

Time: 3 hrs. Max. Marks:100

Note: ***Answer any FIVE full questions, selecting at least TWO questions from each part.***

PART – A

1 a. Enumerate the differences between the continuous time $\left(e^{jw_0t}\right)$ and discrete time $\left(e^{j\Omega_0 n}\right)$ exponential signals. **(04 Marks)**

b. Define continuous time and discrete time unit impulse and unit step functions. How are they related? **(04 Marks)**

c. Define energy signal and power signal. The raised cosine pulse x(t) shown in Fig.Q1(c) is defined as $x(t)=\begin{cases}\frac{1}{2}[\cos(\omega t)+1] & \frac{-\pi}{\omega}\le t\le \pi/\omega \\ 0 & \text{otherwise}\end{cases}$ **(08 Marks)**

d. Determine the even and odd parts of the signal depicted in Fig.Q1(d). **(04 Marks)**

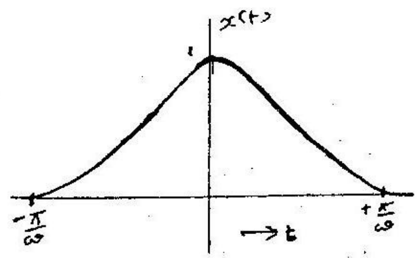


Fig.Q1(c)

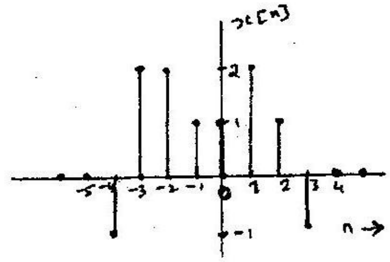


Fig.Q1(d)

2 a. A triangular pulse signal x(t) is depicted in Fig.Q2(a). Sketch each of the following signals derived from x(t): i) x(-2t – 1) ii) x(2(t + 2)) **(04 Marks)**

b. Determine whether the following systems are memoryless, stable and causal:

i) $y[n]=\log_{10}(|x[n]|)$ ii) $y[t]=\frac{d}{dt}(e^{-t}x[t])$ **(06 Marks)**

c. For the system represented in Fig.Q2(c), express h[n], the overall system from x[n] to y[n] in terms of $h_1[n]$, $h_2[n]$ and $h_3[n]$, given $h_1[n]=\left(\frac{1}{2}\right)^n[u(n+2)-u(n-3)]$; $h_2[n]=\delta(n)$ and $h_3[n]=u(n-1)$. **(10 Marks)**

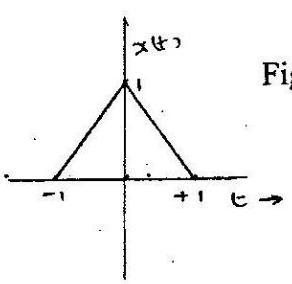


Fig.Q2(a)

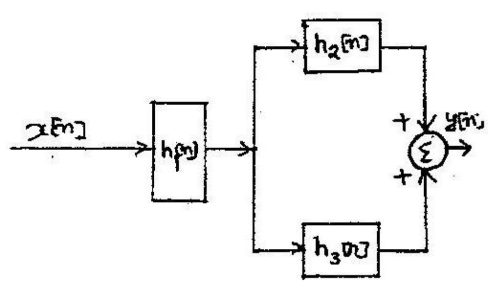


Fig.Q2(c)

3 a. Evaluate the convolution integral of signals $h(t)=e^{-t}u(t)$ and $x(t)=u(t)$. **(05 Marks)**

b. Using the classical method, determine the response of the linear time invariant discrete time system described by the following difference equation with input and initial conditions specified : $y[n]-\frac{1}{9}y(n-2)=x(n-1)$; $y(-1)=1, y(-2)=0, x(n)=u(n)$ **(09 Marks)**

c. Derive the direct form I and direct form II implementation of the following system :

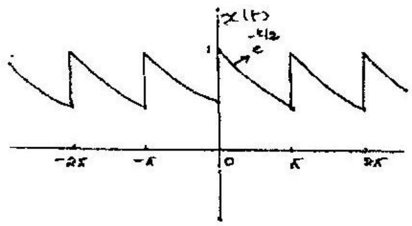
$$\frac{d^3y(t)}{dt^3}+\frac{2dy(t)}{dt}+3y(t)=x(t)+\frac{3dx(t)}{dt}$$ **(06 Marks)**

4 a. Find the exponential Fourier series for the signal shown in Fig.Q4(a). Also plot the Fourier spectra. **(10 Marks)**

b. State Parseval's theorem as applied to Fourier series representation of signals. **(04 Marks)**

c. Relate the Fourier series coefficients of the signal y(t), which is related to x(t) as:
i) $y(t)=x(t-t_0)$ ii) $y(t)=x(-t)$ **(06 Marks)**

Fig.Q4(a)



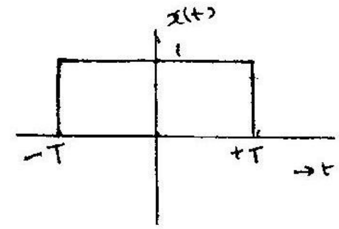


Fig.Q5(a)

PART – B

5 a. Determine the Fourier transform of rectangular pulse as shown in Fig.Q5(a) and plot the same. **(08 Marks)**

b. State and prove time domain convolution and frequency domain convolution property of continuous time Fourier transform. **(08 Marks)**

c. Use partial traction expansion and linearity property to determine the inverse Fourier transform of $x(j\omega)=\frac{-j\omega}{(j\omega)^2+j3\omega+2}$. **(04 Marks)**

6 a. Find the DTFT of $\gamma^n u[-(n+1)]$. **(07 Marks)**

b. Define and prove frequency differentiation and frequency shifting property of DTFT. **(06 Marks)**

c. Using the concept of Fourier representation, obtain frequency response of system described by following impulse response $h(t)=4e^{-2t}\cos(20t)u(t)$. **(07 Marks)**

7 a. Determine the solution of the difference equation $y(n)-\frac{3}{4}y(n-1)+\frac{1}{8}y(n-2)=2x(n)$; $x(n)=\left(\frac{1}{4}\right)^n u(n)$ using Fourier representation. **(07 Marks)**

b. Find the z-transform of i) $n\gamma^n u(n)$ ii) $\cos\beta n\, u(n)$, specify ROC. **(05 Marks)**

c. Define initial value theorem and final value theorem as applied to z - transforms. Also specify the conditions for applicability of the same. **(04 Marks)**

d. State and explain sampling theorem. **(04 Marks)**

8 a. A stable and causal system described by the difference equation:

$$y(n)+\frac{1}{4}y(n-1)-\frac{1}{8}y(n-2)=2x(n)+\frac{5}{4}x(n-1).$$

Find system impulse response using z-transform. **(07 Marks)**

b. Find the inverse z-transform of :

i) $\frac{z(2z-1)}{(z-1)(z+0.5)}$ ii) $\frac{9}{(z+2)(z-0.5)^2}$ iii) $\frac{5z(z-1)}{z^2-1.6z+0.8}$ **(09 Marks)**

c. Define stability and causality of linear time invariant discrete time system defined by transfer function. **(04 Marks)**