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B.E./B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2008.

Fourth Semester

(Regulation 2004)

Electronics and Communication Engineering

EC 1252 — SIGNALS AND SYSTEMS

(Common to B.E. (Part-Time) Third Semester Regulation 2005)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — ($10 \times 2 = 20$ marks)

1. Find the even and odd components of the signal $x(t) = e^{jt}$.

2. Determine the complex Fourier series representation of the signal $x(t) = \sin w_0 t$.

3. Find the Laplace transform of unit ramp function.

4. Determine whether the impulse response of a LTI system $h(t) = \frac{10 \sin(5\pi t)}{\pi t}$ is causal or not.

5. What is the z-transform and the associated ROC of the signal $x(n) = u(n - n_0)$?

6. Give the relationship between z-transform and Fourier transform.

7. Find the transfer function of the discrete time system

$$y(n) - \frac{3}{4} y(n-1) + \frac{1}{8} y(n-2) = x(n).$$

8. State the condition for a discrete-time LTI system to be causal and stable.

9. Define recursive and non-recursive discrete time system.

10. List the different types of structures for realization of IIR systems.

PART B — (5 × 16 = 80 marks)

11. (a) (i) Determine the energy and power of the following signals :

(1) $x(t) = t\,u(t)$

(2) $x(n) = 2e^{j3n}$. (8)

(ii) Find the Fourier series representation of the signal

$x(t) = 2\sin(2\pi t - 3) + \sin(6\pi t)$ (8)

Or

(b) (i) A discrete-time signal $x(n)$ is shown in figure 11 (b) (i) sketch and label each of the following signals.

(1) $x(n)\,u(1-n)$

(2) $x(n)\,\delta(n-1)$

(3) $x(n)[u(n+2) - u(n)]$. (9)

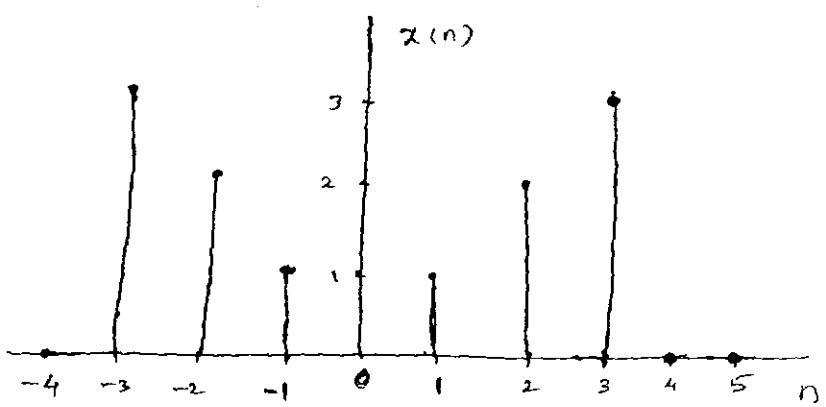


Fig. 11 (b) (i)

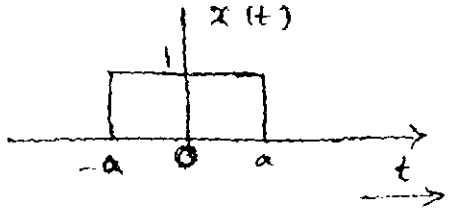
(ii) Determine whether or not the given signals are periodic.

(1) $x(t) = \sin^2 t$

(2) $x(n) = \cos\left(\frac{1}{4}n\right)$. (4)

(iii) Evaluate the integral $\int_{-2}^{4} \left(t + t^2\right)\delta(t-3)dt$. (3)

12. (a) (i) Find the Fourier transform of the signal shown in Fig. 12 (a) (i)



(5)

Fig. 12 (a) (i)

(ii) State and prove the time scaling property of Laplace transform. (6)

(iii) The output response $y(t)$ of a continuous time LTI system is $2e^{-3t}u(t)$ when the input $x(t)$ is $u(t)$. Find the system function. (5)

Or

(b) (i) State and prove the differentiation property of Fourier transform.(6)

(ii) Consider a continuous time LTI system

$$\frac{d^2y(t)}{dt^2}+\frac{dy(t)}{dt}-2y(t)=x(t)$$

(1) Find the system function $H(S)$

(2) Determine if the impulse response $h(t)$ for the system is causal, the system is stable and the system is neither causal nor stable. (10)

13. (a) (i) Find the Nyquist frequency and Nyquist rate for each of the following signals :

(1) $x(t)=25\cos(500\pi t)$

(2) $x(t)=15\sec t\ (t/2)$ (8)

(ii) Determine the initial and final values for the signal $x(n)$ with transfer function $x(z)=\dfrac{z^3-\frac{3}{4}z^2+2z-\frac{5}{4}}{(z-1)\left(z-\frac{1}{3}\right)\left(z^2-\frac{1}{2}z+1\right)}$. (8)

Or

(b) (i) Find the inverse z-transform of $x(z)=\dfrac{z^3-z^2+z-\frac{1}{16}}{z^3-\frac{5}{4}z^2+\frac{1}{2}z-\frac{1}{16}}$, $|z|>\dfrac{1}{2}$.

(8)

(ii) Draw the Pole-zero plot for the discrete-time system described by the difference equation (8)

$$y(n)-2y(n-1)+2y(n-2)=x(n)+\frac{1}{2}x(n-1)$$

14. (a) (i) When an input $x(n)=3\delta(n-2)$ is applied to a causal LTI system, whose output is found to be $y(n)=2\left(-\frac{1}{2}\right)^n+8\left(\frac{1}{4}\right)^n$. Find the impulse response $h(n)$ of the system. (8)

(ii) Find the overall response of the system shown in figure 14 (a) (ii) with $h_1(n)=\delta(n)$, $h_2(n)=(n-1)u(n)$ and $h_3(n)=\delta(n)+nu(n-1)+\delta(n-2)$. (8)

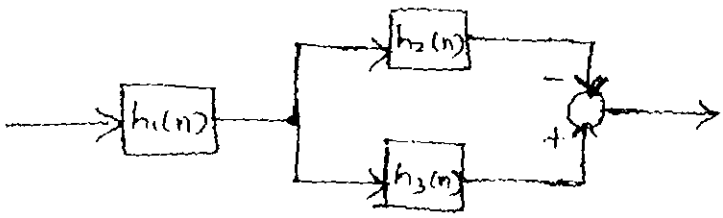


Fig. 14 (a) (ii)

Or

(b) (i) Determine the characteristic roots and the homogenous solution for the difference equation

$$y(n)-\frac{5}{4}y(n-1)+\frac{1}{2}y(n-2)-\frac{1}{16}y(n-3)=x(n) \quad (10)$$

(ii) Construct the block diagram for the discrete time system (6)

$$y(n)=0.5y(n-1)+x(n)-2x(n-2)$$

15. (a) (i) Derive the transfer function of FIR and IIR system. (8)

(ii) Realize the given system with minimum number of multipliers. (8)

$$H(z)=\frac{1}{4}+\frac{1}{2}z^{-1}+\frac{3}{4}z^{-2}+\frac{1}{2}z^{-3}+\frac{1}{4}z^{-4}$$

Or

(b) Realize the given discrete-time system in cascade and parallel forms

$$H(z)=\frac{1+\frac{1}{2}z^{-1}}{\left(1-z^{-1}+\frac{1}{4}z^{-2}\right)\left(1-z^{-1}+\frac{1}{2}z^{-2}\right)} \quad (16)$$