B.E. DEGREE EXAMINATIONS: APRIL/MAY 2012

Fourth Semester

ELECTRONICS AND COMMUNICATION ENGINEERING

ECE107: Signals and Systems

Time: Three Hours   **Maximum Marks: 100**

Answer ALL Questions:-

PART A (10 x 1 = 10 Marks)

1. The discrete-time signal $x(n) = (-1)^n$ is periodic with fundamental period

   A.6   B.4   C.2   D.0

2. $x[n] = a^{|n|}, |a| < 1$

   A. an energy   B. a power signal

   C. neither an energy nor a power signal   D.an energy as well as a power signal

3. A useful property of the unit impulse $\delta(t)$ is that

   A. $\delta(at) = a\delta(t)$ B. $\delta(at) = \delta(t)$ C. $\delta(at) = \frac{1}{a}\delta(t)$ D. $\delta(at) = [\delta(t)]^a$

4. The Fourier transform of the exponential signal $e^{j\omega_0 t}$ is

   A. a constant   B.a rectangular gate   C.an impulse   D. a series of impulse

5. The signals $x_1(t)$ and $x_2(t)$ are both band limited to $(-\omega_1, +\omega_1)$ and $(-\omega_2, +\omega_2)$ respectively. The Nyquist sampling rate for the signal $x_1(t) . x_2(t)$

   A. $2\omega_1$ if $\omega_1 > \omega_2$ B. $2\omega_2$ if $\omega_1 < \omega_2$ C. $2(\omega_1 + \omega_2)$ D. $\frac{(\omega_1 + \omega_2)}{2}$

6. A band pass signal extends from 1KHz to 2KHz. The minimum sampling frequency needed to retain all information in the sampled signal is

   A.1KHz.   B.2KHz.   C.3KHz.   D.4KHz.

7. Two sequences $x_1(n)$ and $x_2(n)$ are related by $x_2(n) = x_1(-n)$.In the z- domain, their ROC'sare

   A.the same.   B. reciprocal of each other.

   C. negative of each other   D. complements of each other.

8. The relationship between DTFT and z-transform is:

   A. $z = e^{jw}$ B. $z = jw$ C. $w = z^n$ D. $w = z^{-n}$

9. The impulse response of the system $h[n]=a^n u[n]$.The condition for the system to be BIBO stable

   A. a is real and positive   B. a is real and negative   C. $|a| < 1$ D. $|a| > 1$

10. The unit sample response of an LTI system is the unit step u(t).For t>0 the response of an system to an excitation $e^{-at}u(t)$ will be

   A. $ae^{-at}u(t)$ B. $\dfrac{1-e^{-at}u(t)}{a}$ C. $a\left(1-e^{-at}u(t)\right)$ D. $1-e^{-at}u(t)$

PART B (10 x 2 = 20 Marks)

11. Check whether the signal $x(t)=2\cos 3\pi t+7\cos 9t$ is periodic or not.

12. Define Causality and stability of a system with an example for each

13. State Dirichlet condition for existence of Fourier series.

14. Find the Fourier transform of $\delta(t)$

15. What is an anti-aliasing filter?

16. An analog signal has the spectrum shown in Fig .1. What is the minimum sampling rate needed to completely represent this signal?
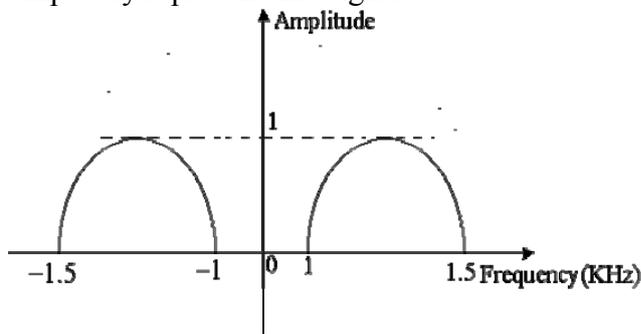

17. The z- transform of a sequence x(n) is X(z), what is the z-transform of nx(n)?

18. State forward and inward equations of DTFT.

19. What is the impulse response of two system connected in parallel?

20. Find the convolution of the following sequences $x(n) = \{\overset{\uparrow}{1},2,1\}$ $h(n) = \{\overset{\uparrow}{1},1,1\}$

PART C (5 x 14 = 70 Marks)

21. a) (i) Consider the signal x(t) as shown in the figure 2. Plot the following signal

   1) x(t+1)   2) x(t +1)   3) $x(\tfrac{3}{2}t)$ 4) $x(\tfrac{3}{2}t+1)$ (8)
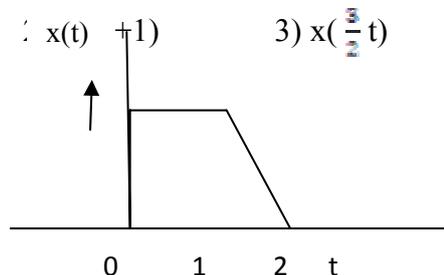
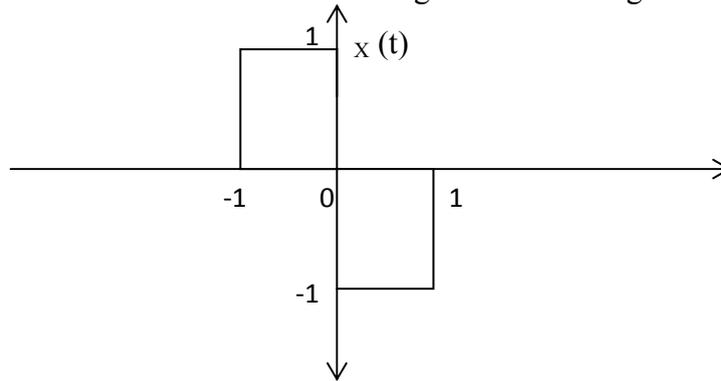   (ii) Explain periodicity property of discrete time complex exponential.   (6)

(OR)

  b) (i) Find the exponential Fourier Series Coefficient of the signal

$$x(t) = \begin{cases} 1 & ; |t| < T_1 \\ 0 & ; T_1 < |t| \le T/2 \end{cases}$$ (10)

(ii) Determine the Fourier series representation for x(t)= $2\sin(2\pi t - 3) + \sin(6\pi t)$ (4)

22. a) (i) Find the Fourier transform of the signal shown in figure3.   (8)

(ii) State & prove differentiation in time domain property of Fourier transform. (6)

(OR)

b) (i) Find the convolution of two signals.

$$x(t) = \begin{cases} 1, & 0 < t < T \\ 0, & otherwise \end{cases} \qquad h(t) = \begin{cases} 1, & 0 < t < 2T \\ 0, & otherwise \end{cases}$$ (7)

(ii) Consider the a stable LTI system that is characterized by the difference equation

$\dfrac{d^2 y(t)}{dt^2} + 4\dfrac{dy(t)}{dt} + 3y(t) = \dfrac{dx(t)}{dt} + 2x(t)$. Find the impulse response h(t) using Fourier

transformation.   (7)

23. a) (i) Explain how an analog signal can be converted to discrete signal to using impulse train sampling discrete signal.   (7)

   (ii) Explain the reconstruction of the original signal from the sampled Signal.   (7)

(OR)

b) (i) Explain sampling of discrete time Signal with necessary diagrams.

24. a) (i) Find the DTFT of $x[n] = a^n u[n]$ .Plot the magnitude response.   (7)

   (ii) State and Prove Parseval's theorem of DTFT.   (7)

(OR)

b) (i) Find Inverse z-transform of $X(z) = \log(1 + az^{-1}); |z| > |a|$ using differentiation property.   (6)

   (ii) Determine the convolution of pairs of signals by means of the z-transform $x_1(n) = \left(\dfrac{1}{2}\right)^n u(n); x_2(n) = Cos\pi n\ u(n)$ (8)

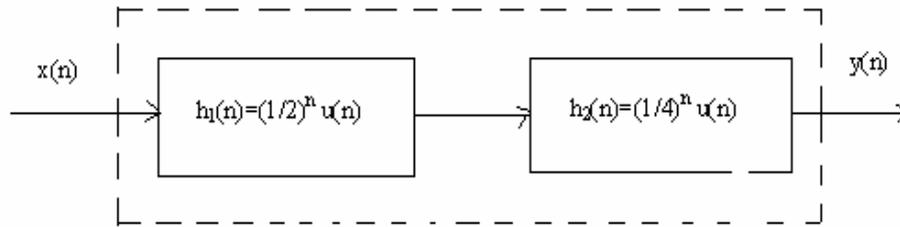25. a) (i) Find the unit step impulse of the following system

$y(n) = x(n) + 2x(n-1) - 4x(n-2) + x(n-3)$ (5)

   (ii) State and prove the properties of Convolution.   (9)

(OR)

b) (i) Two Discrete time LTI systems are connected in cascade as shown in the figure 4. Determine the unit sample response of this cascade connection. (7)

$$x(n) \quad h_1(n)=(1/2)^n u(n) \quad h_2(n)=(1/4)^n u(n) \quad y(n)$$

(ii) Obtain the cascade direct form II realization of the system described by the difference equation. $y(n)-\dfrac{13}{12}y(n-1)+\dfrac{9}{24}y(n-2)-\dfrac{1}{24}y(n-3)=x(n)+2x(n-1)$ (7)

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