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B.E DEGREE EXAMINATIONS: MAY/JUNE 2013

Fourth Semester

ELECTRONICS AND COMMUNICATION ENGINEERING

ECE107: Signals And Systems

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

Answer all the Questions

PART A (10 x 1 = 10 Marks)

1. The value of the integral $\int_{-2}^{3} cos\pi t\, \delta(t-1)dt$ is

    a)   -1   b)   1

    c)   0   d) π

2. State which of the following statements are true:

    i)   All periodic signals are power signals

    ii)   All power signals are periodic signals

    iii)   A signal can either be an energy signal or a power signal

    iv)   A signal can be an energy signal as well as a power signal

    a)   (i) and (iii)   b)   (i) and (ii)

    c)   (i) and (iv)   d)   (ii) and (iv)

3. The impulse response of two systems connected in cascade are $h_1[n] = u[n]$ and

    $h_2[n] = \delta[n-1]$ respectively. The overall impulse response $h[n]$ of the system is

    a) $u[n]$ b) $u[n-1]$

    c) $u[n] - \delta[n-1]$ d) $u[n] + \delta[n-1]$

4. The Fourier transform of a DC signal is

    a)   0   b)   1

    c) π d) $2\pi\delta(\Omega)$

5. If $x(t)$ is a band-limited signal with B Hz. The Nyquist sampling frequency for $x(2t)$ is

    a) B Hz   b) $4B$ Hz

    c) $2B$ Hz   d) $B/2$ Hz

6. The Nyquist rate for the analog signal is 50π rad/sec. The bandwidth of the signal is

    a)   25 Hz   b)   12.5 Hz

    c)   50 Hz   d)   10 Hz

7. The DTFT of $\delta[4-2n]$ is

    a) $e^{j\omega}$ b) $e^{-j4\omega}$

c) $e^{-j\omega}$ d) $e^{-j2\omega}$

8. If $X(e^{j\omega})$ is the DTFT of $x[n]$, then the DTFT of $x[-n]$ is

   a) $X(e^{-j\omega})$ b) $X(e^{j\omega})$

   c) $-X(e^{j\omega})$ d) $1/X(e^{j\omega})$

9. Given $X(z)= 2z^2 - 2z + 1 - 2z^{-2}$. The ROC of $X(z)$ is

   a) Entire z - plane   b) Entire z - plane except $z=0$

   c) Entire z - plane except $z=0$ and $z=\infty$ d) Entire z - plane except $z=\infty$

10. If the z transform of a signal is $X(z)$, then the z transform of $x[n-2]$ is

   a) $z^2 X(z)$ b) $z^{-2} X(z)$

   c) $X(z)$ d) $2 X(z)$

PART B (10 x 2 = 20 Marks)

11. Determine whether the signal $x[n]= \cos 2n$ is a periodic signal or not. If periodic, find the fundamental period. If aperiodic, justify.

12. Represent $x[n] = \{1,2,3,2,0,2\}$ as a linear combination of weighted shifted impulse functions.

13. An LTI system with impulse response $h(t)= e^{-at}u(-t-1)$ is excited by an input $x(t)= 2\delta(t-2)$. What is the response $y(t)$ of the system ?

14. State Parseval's relation for continuous time aperiodic signals. Also specify its significance.

15. Under what conditions, aliasing can be avoided ?

16. What is the Nyquist rate of the signal $x(t)=1+ 2\cos 50\pi t + \sin 100\pi t$?

17. Given the DTFT of a sequence $x[n]$ as follows $X(e^{j\omega})= 2e^{2j\omega} + 3 - 2e^{-j\omega} + 4e^{-3j\omega}$. Determine x[n].

18. Define Region of Convergence.

19. Given $x[n]= \{a,2,b\}$, $h[n]= \{c,1,2\}$ and $x[n]*h[n]= \{-2,-3,-2,7,6\}$. Determine the values of a,b and c.

20. Determine whether the system $y[n]= x^2[n]$ is an invertible system or not. Justify your answer.

PART C (5 x 14 = 70 Marks)

21. a)   Sketch the following signals:

   i) $x(t) = \frac{t}{2}[u(t) - u(t-2)]$

ii) $x_1(t) = x\left(-t - \frac{1}{2}\right)$

iii) $x_2(t) = x\left(\frac{t}{2} + \frac{1}{2}\right)$

iv) $x_3(t) = x\left(-2t + \frac{1}{2}\right)$

(OR)

b)   (i)   Determine the even and odd components of the signal $x(t) = \sin\left(\Omega_0 t + \frac{\pi}{4}\right)$ (7)

    (ii)   Determine the complex exponential Fourier series representation of the signal   (7)

        $x(t) = \cos 4t + \sin 6t$

22. a)   Convolve the following signals

        $x(t) = e^{-3t}u(t)$ and $h(t) = u(t+3)$

(OR)

b)   Determine whether the following continuous time system is static, causal, linear and time invariant.

        $y(t) = at^2 x(t) + bt\, x(t-4)$

23. a)   State and prove sampling theorem with necessary quantitative analysis and illustrations.

(OR)

b)   Given $x(t) = 5 \sin 10\pi t$. Find the discrete time signal, if $x(t)$ is sampled at a sampling rate $Fs = 15\,Hz$. Also find the reconstructed output using an ideal low pass filter.

24. a)   Find the DTFT of $x[n] = a^{|n|}, |a| < 1$. Plot its magnitude spectrum and phase spectrum.

(OR)

b)   Determine   the   z-transform   of   the   signal $x[n] = (1/2)^n u[-n-1] + (1/3)^n u[-n-1]$. Specify its ROC and also plot its pole-zero diagram.

25. a)   Let   the   Fourier   transform   of   the   signals $x[n]$ and $h[n]$ be

        $X(e^{j\omega}) = 2e^{j\omega} + 1 + 2e^{-j\omega} - 2e^{-2j\omega}$ and $H(e^{j\omega}) = 1 + 2e^{-j\omega} - 2e^{-3j\omega}$.   Determine $y[n] = x[n] * h[n]$. Verify the result using any one method used for discrete convolution.

(OR)

b)   A   causal   DT   LTI   system   is   characterized   by $y[n] - 5/6\, y[n-1] + 1/6\, y[n-2] = x[n]$. Find the system function $H(z)$ impulse response $h[n]$ of the system.

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