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Register Number: ……..

B.E DEGREE EXAMINATIONS: MAY 2015

(Regulation 2009)

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 continuous time system described by $y(t) = x(t^2)$ is

   a) causal, linear and time varying.
   b) causal, non-linear and time varying.
   c) non causal, non-linear and time-invariant
   d) non causal, linear and time-invariant.

2. $X(n) = a^{|n|}$; $|a| < 1$, is

   a) an energy signal.
   b) a power signal.
   c) neither an energy nor a power signal.
   d) an energy as well as a power signal.

3. The Fourier transform of the exponential signal e^{jwot} is

   a) a constant.
   b) a rectangular gate.
   c) an impulse.
   d) a series of impulses

4. The FT of a rectangular pulse existing between t = - T/2 to t = T / 2 is a

   a) sinc squared function.
   b) sinc function.
   c) sine squared function.
   d) sine function.

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

   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) $(\omega_1 + \omega_2) / 2$

6. What is the Nyquist Frequency for the signal $x(t) = 3\cos 50\pi t + 10\sin 300\pi t - \cos 100\pi t$?

   a) 50 Hz
   b) 100 Hz
   c) 200 Hz
   d) 300 Hz

7. The function which has its Fourier transform, Laplace transform, and Z transform unity is

   a) Gausian b) impulse

   c) Sinc d) pulse

8. The region of convergence of a causal finite duration discrete time signal is

   a) The entire 'z' plane except z = 0 b) The entire 'z' plane except z = ∞

   c) The entire 'z' plane d) A strip in z-plane

9. Which of the following schemes of system realization uses separate delays for input and output samples?

   a) parallel form b) cascade form

   c) direct form-I d) direct form-II

10. Let h [n]{1,2,0,-1,1} and x[n] = {1,3,-1,-2} be two discrete time sequences. What is the value of convolution y[n]= x[n] * h[n] at n =4 ?

    a) -5 b) 5

    c) -6 d) -1

PART B (10 x 2 = 20 Marks)

11. Find the numerical value of the integral.

$$\int_{1/2}^{5/2} \delta_2(3t)\,dt$$

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12. A signal x is periodic with fundamental period T_0 =6. This signal is described over the time period
    0 < t < 6 by, rect((t-2)/3)+ 4 rect((t-4)/2). What is the average signal power of this signal
13. Compare double sided and single sided spectrums
14. State the convolution property of fourier transform.
15. How many sample values are required to yield enough information to exactly describe the bandlimited periodic signals?
    x(t)= 8 + 3cos(8πt) + 9 sin(4πt)
16. What is anit-aliasing filter?
17. What are the Dirichlet conditions for the existence of the DTFT?
18. How is DTFT related to the *z*-transform of the same discrete-time signal?
19. If a system function has zeros at the origin of the *z*-plane then the system function is a proper rational function. Why?
20. How is the direct form II structure obtained from the direct form I structure?

PART C (5 x 14 = 70 Marks)

21. a) (i) Mention the classification of continuous time signals and briefly discuss each with one example. (7)

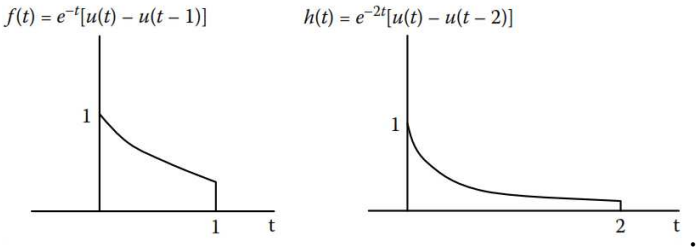
(ii) How do you represent any arbitrary signal in terms of delta function and its delayed function? (7)

(OR)

b) (i) State and prove the relationship between δ(t) & u(t) and δ[n] & u[n] (7)

(ii) State and prove parseval's theorem for periodic signals (7)

22. a) (i) Find the convolution of the functions shown in Figure (7)



(ii) State and prove the frequency differentiation property of Fourier Transform. (7)

(OR)

b) Find the Fourier Transform of the signal x(t) and plot the amplitude spectrum

$$x(t) = \begin{cases} 1 & -\iota/2 \leq t \leq \iota/2 \\ & \text{otherwise} \end{cases}$$

23. a) The signal x(t) = 10 cos 150πt is ideally sampled at a frequency f_s = 200 samples per second. Sketch the spectrum of x_δ (t). Also sketch the spectrum of x_δ (t) if the sampling is done at a frequency f_s = 100 samples per second. (10)

A signal x(t) = 2 cos (400πt) + 6 cos (640πt) is ideally sampled at f_s = 500Hz. If the sampled signal is passed through an ideal LPF with a cutoff frequency of 400Hz, what frequency components will appear in the output? (4)

(OR)

b) Consider a continuous-time signal $x_c(t) = 2\cos(10\pi t - 60^o) - 3\sin(16\pi t)$. It is sampled at $t = 0.05n$ to obtain $x[n]$ which is then applied to an ideal DAC to obtain another continuous-time signal $y_r(t)$.
(i) Determine $x[n]$ and graph its samples along with the signal $x(t)$ in one plot.
(ii) Determine $y_r(t)$ as a sinusoidal signal. Graph and compare it with $x(t)$.
(iii) Repeat (i) and (ii) for sampling at $t = 0.1n$. Comment on your results.

24. a) (i) Assuming no time-domain aliasing, describe the practical approach used in reconstruction of the DTFT from its equally-spaced samples. What is this technique known as? (7)

(ii) Determine the DTFT of $x[n] = 1 \quad 0 \le n \le 5$ (7)

0 Otherwise

(OR)

b) (i) Obtain z- transform for (7)
(i) $x1(n) = (1/3)^n [\sin(\pi n / 4)] u(n)$
(ii) $x2(n) = -a^n u(-n-1)$
Plot pole –zero diagram and state ROC for both.

(ii) State initial value theorem for Z-transform. List its utility. For the sequence $x(n) = 7(1/3)^n u(n) - 6(1/2)^n u(n)$, find x(0) using initial value therom. (7)

25. a) An LTI system has an impulse response $h(t) = \exp[-at] u(t)$; when it is excited by an input signal x (t), its output is $y(t) = [\exp(-bt) - \exp(-ct)] u(t)$ Determine its input x (t).

(OR)

b) Obtain the Cascade and parallel form realization for the system described by the differential equation $d^2y(t)/dt^2 + 5dy(t)/dt + 4y(t) = dx(t)/dt$

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