Register Number:……………………..

**B.E DEGREE EXAMINATIONS: NOV/DEC 2014**

(Regulation 2009)

Fourth Semester

**ELECTRONICS AND COMMUNICATION ENGINEERING**

ECE 107: Signals and Systems

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

**Answer all the Questions:-**

**PART A (10 x 1 = 10 Marks)**

1. The unit step signal in terms of unit impulses is given by

a) $\sum_{m=-\infty}^{n}\delta[m]$ b) $\sum_{m=0}^{\infty}\delta[m]$

c) $\sum_{k=-\infty}^{\infty}\delta[n-k]$ d) $\sum_{k=0}^{\infty}\delta[n-k]$

2. Given a function x (t) =t+2, for$0\leq t\leq 4$. The function x (t-2) =……………

a) t, for$2\leq t\leq 6$ b) t-2, for$0\leq t-2\leq 4$

c) t, for$0\leq t\leq 4$ d) t-2, for$0\leq t\leq 4$

3. The Fourier Transform of $d^n/dt^n$ {x(t)} is

a) (jΩ) X(jΩ) b) $(j\Omega)^n X(j\Omega)$

c) $(j\Omega)^n X(j\Omega)^n$ d) $(j\Omega) X(-j\Omega)^n$

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

a) Constant b) A rectangular gate

c) An impulse d) A series of impulses

5. The Nyquist interval for the signal x(t) = 2sinc(200πt)$\text{sinc}^2$(400πt) is

a) 0.005s b) 0.0025s

c) 0.001s d) 0.00125s

6. A signal x (t) = 2sin $\Omega_0$t is sampled. Aliasing results when one of the following sampling frequencies is chosen. Identify that sampling frequency.

a) $\Omega_0 = \Omega_s /3$ b) $\Omega_{0=}$ (3/2) $\Omega_s$

c) $\Omega_0 = (3/7)\Omega_s$ d) $\Omega_0 =(2/6)\Omega_s$

7. The system is BIBO stable and causal if the poles of system function H(z) lie

   a) outside the unit circle of the z -plane  b) inside the unit circle of the z -plane

   c) on the unit circle of the z -plane  d) both (a) and (c)

8. The DTFT and Z transform are related by

   a) $Z=e^{-j\omega}$  b) $Z=1/e^{j\omega}$

   c) $Z=e^{j\omega}$  d) $Z=1/e^{-j\omega}$

9. If a DT LTI system is such that the output signal is always identical to the input signal, then the impulse response of the system is

   a) an unit impulse  b) an unit step

   c) all zero signal  d) all ones signal

10. Which of the following represents the impulse response of a system defined by $H(z) = z^{-m}$

   a) u(n-m)  b) δ(n-m)

   c) δ(m)  d) u(m)

**PART B (10 x 2 = 20 Marks)**

11. Find whether the given signal is an energy signal or power signal x[n] = cos(0.1πn)
12. State and prove time scaling property of continuous Time Fourier Series
13. State the Dirchilet's conditions for the Fourier Transform
14. If $x(t) \overset{FT}{\leftrightarrow} X(j\omega)$ find the Fourier transform of 2x(-t)
15. What is aliasing? How is it minimized?
16. What do you mean by decimation and interpolation?
17. Find the DTFT of the signal x[n] = u [n-2] – u [n-6].
18. State the properties of ROC of Z- Transform.
19. What is the Z-transform of the sequence x (n) = $a^n$u(n)?
20. Find the convolution of x[n] = {1, -1, 1, -1} and h[n] = {2, 2, 2, 2}.

**PART C (5 x 14 = 70 Marks)**

21. a) (i) Determine whether the following signals are energy signals, power signals, or neither. a) x(t) = cos (πt/2 + π/4) b) $x(n)=(-0.5)^n u(n)$ (8)

   (ii) What is signal? Classify the signals on various properties. (6)

**(OR)**

   b) (i) State and prove the multiplication property and Parseval's theorem for continuous Time Fourier Series. (8)

(ii) Find the Fourier Series coefficients, $a_k$ for the given signal x (t) = (1/2) + cos(t) + (1/4)cos(2t) and plot its magnitude spectrum. (6)

22. a) (i) Find the Fourier transform of the signal y(t) = x(t) + x(-t) and sketch the spectrum, where (6)

$$x(t) = \begin{cases} e^{-t}, & 0 \le t \le 1 \\ 0, & \text{elsewhere} \end{cases}$$

(ii) State the properties of convolution integral and prove them. (8)

**(OR)**

b) Given x (t) =$e^{-3t}$u (t) and h (t) =tu(t), obtain the response y(t) of a system described by h(t) using convolution integral. (8)

Determine the time domain signal for the following Fourier transform (6)

$$X(j\omega) = \begin{cases} 2j, & 0 \le \omega \le \pi \\ -2j, & -\pi \le \omega \le 0 \end{cases}$$

23. a) State sampling theorem and define Nyquist rate. Given x(t)=5sin10πt, find the Discrete time signal obtained $x_d(t)$, if x(t) is sampled at a sampling rate of 30Hz. Also find the reconstructed output by using ideal low pass filter.

**(OR)**

b) Draw the block diagram for discrete time processing of continuous time signals and explain the function of each block. Also discuss the design of digital differentiator.

24. a) A causal and stable LTI system has the Frequency response $H(j\omega) = \frac{j\omega + 4}{6 - \omega^2 + 5j\omega}$

(i) Determine the differential equation relating the input x(t) and output y(t) of the system (3)

(ii) Determine the impulse response of the system (3)

(iii) State the convolution property of Discrete Time Fourier transforms. Determine the output of the system above when the input is x (t) = $e^{-4t}$u (t) - t $e^{-4t}$u (t) using convolution property (8)

**(OR)**

b) (i) Given $x[n] = a^n u[-n]$ and $h[n] = b^n u[n]$, $0< |a| < 1$, $0< |b| < 1$, $|b| < |a|$, find the response y[n]. (8)

(ii) Find the Fourier transform of i) $x[n] = u[n] – u[n-1]$ (6)

ii) $x[n] = -a^n u[-n-1]$

25. a) An LTI system is represented by the following difference equation

$y[n] – (1/4)y[n-1]-3/8y[n-2] = -x[n]+2x[n-1]$. Determine

(i) The system function H(z) (2)

(ii) The frequency response $H(e^{j\omega})$ (2)

(iii) The impulse response h(n) (4)

(iv) The response of system to input $x[n] = (1/2)^n u[n]$ (6)

**(OR)**

b) (i) The transfer function of three systems are $H_1$ (Z), $H_2$ (Z) and $H_3$ (z). Draw the block diagram of the following systems. (8)

i) $H(z) = H_1(z) + H_2(z) + H_3(z)$

ii) $H(z) = \{H_1(z) + H_2(z) \} H_3(z)$

iii) $H(z) = \{H_1(z) \ H_2(z)\} - H_3(z)+ H_1(z)$

iv) $H(z) = H_1(z) \ H_2(z) + H_3(z) H_1(z) + H_2(z) H_3(z)$

(ii) A Causal LTI system has the following difference equation (6)

$Y[n] -1/2y [n-1] +1/4y [n-2] = x[n]$. Determine the impulse response and also check the stability of this system with the help of z plan ROC.

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