G 578 (Pages : 4) Reg. No..........................

Name..........................

B.TECH. DEGREE EXAMINATION, MAY 2014

Fourth Semester

Branch : Electronics and Communication/Applied Electronics and Instrumentation/Electronics and Instrumentation/Information Technology

SIGNALS AND SYSTEMS (L, A, S, T)

(Old Scheme—Prior to 2010 Admissions)

[Supplementary/Mercy Chance]

Time : Three Hours Maximum : 100 Marks

Part A

Answer **all** *questions.*
Each question carries 4 marks.

1. Determine the odd and even parts for the following signals :

   (a) $x(t) = u(t+1)$. (b) $x(t) = 2 + 3t + 4t^2 + 5t^3 + 6t^4$.

2. Check whether the following system is linear or not ? Prove the same :

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

3. State and prove the frequency shifting property of continuous Time Fourier Transform.

4. Find the Fourier Transform of $P(t) = \sum_{n=-\infty}^{\infty} \delta(t - n\tau)$, τ - fundamental period.

5. Find the DTFT of $x(n) = \left(\frac{1}{3}\right)^n u(n)$.

6. Find the frequency response of the following LTI system : $h(t) = -\delta(t+1) + \delta(t) - \delta(t-1)$.

7. Find the z-transform with ROC $x(n) = 3e^{-2n} u(n) + 2\left[4^n u(-n)\right] + 5\delta(n)$.

8. What are the conditions to be satisfied by a function to be Laplace Transformable ?

9. Determine whether the function given by the expression $f_x(x) = \begin{cases} 0 & , x < 2 \\ \frac{1}{18}(3+2x), & 2 \le x \le 4 \\ 0 & , x > 4 \end{cases}$ is a density function ?

Turn over

10. Define random process and explain ensemble and sample function.

(10 × 4 = 40 marks)

Part B

Answer **all** *questions.*
Each full question carries 12 *marks.*

11. (a) Find the convolution of $x(n)$ and $h(n)$ where $x(n) = \{1, \underset{\uparrow}{2}, 3, 4\}$ and $h(n) = \{\underset{\uparrow}{2}, 3, 1, 1\}$. (5 marks)

(b) Find the output response of the system described by the differential equation $\frac{d^2y(t)}{dt^2} + 7\frac{dy(t)}{dt} + 12y(t) = \frac{dx(t)}{dt} + x(t)$. (7 marks)

Or

12. (a) Consider the system $y(t) = x(t)\cos w_0 t$. Determine whether the system is memory less, causal, linear, time-in-variant and stable. (7 marks)

(b) Evaluate the frequency response for the LTI system represented by $h(n) = (-1)^n [u(n+2) - u(n-3)]$. (5 marks)

13. Derive the Parseval's theorem. Using the same find the energy of the signal $x(t) = e^{-at} u(t)$ and also energy in the frequency band $|w| \leq 0.5$ rad/sec. (12 marks)

Or

14. (a) Find the frequency response of a continuous system described by $\frac{d^2y(t)}{dt^2} + 5\frac{dy(t)}{dt} + 6y(t) = -\frac{dx(t)}{dt}$.

(7 marks)

(b) The signal $x(t) = 2\cos(200\pi t) + 6\cos(180\pi t)$ is ideally sampled at a frequency of 150 samples per second. The sampled version $x_\delta(t)$ is passed through a unit gain ideal low-pass filter with a cut-off frequency of 110 Hz. What frequency components will be present in the output of the filter ? Write down an expression for its output signal.

(5 marks)

15. (a) Find the DTFT of $x(n) = \left(\frac{1}{2}\right)^n u(n)$ and plot its magnitude and phase spectrum.

(7 marks)

(b) Find the output of the system whose impulse response $h(n) = \left(\frac{1}{2}\right)^n u(n)$, using Fourier Transform, the input to the system is $x(n) = \left(\frac{1}{3}\right)^n u(n)$.

(5 marks)

Or

16. Find the DTFT of the following signals :

(a) $x[n] = a^{|n|}$.

(b) $x[n] = a^{-n} u[-n-1]$; $|a| < 1$.

(c) $x[n] = \sin(w_0 n)$; $w_0 = \frac{2\pi}{5}$.

17. (a) Consider the signal $x(t) = e^{-4t} u(t-1)$. Evaluate its Laplace Transform X (s) and find its ROC.

(6 marks)

(b) Determine the values of the finite numbers A and to such that the LT of $g(t) = Ae^{-5t} u(t - t_0)$ has the same algebraic form as X (s) in the above part 17 (a). What is the ROC corresponding to G (s) ?

(6 marks)

Or

18. Determine the Z-transform of the signal $x[n] = a^n u[n]$ and depict the ROC and the locations of poles and zeros in the Z-plane.

(12 marks)

19. Given two random processes X (t) and Y (t) as

$X(t) = Z_1(t) + 3Z_2(t-\tau)$, $Y(t) = Z_2(t+\tau) + 3Z_1(t-\tau)$. Here $Z_1(t)$ and $Z_2(t)$ are independent white noise processes each with a variance = 0.5. Determine (a) autocorrelation functions of X (t) and Y (t) and (b) cross-correlation function of $X(t)$ and $Y(t)$.

(12 marks)

Or

20. (a) A random process provides measurements x between the values 0 and 1 with a PDF of

$$f_X(x) = 12x^3 - 21x^2 + 10x, \text{ for } 0 \le x \le 1$$
$$= 0 \quad \text{otherwise.}$$

Determine the following :

(i) $P\left[X \le \frac{1}{2}\right]$ and $P\left[X > \frac{1}{2}\right]$.

(ii) Obtain a number K such that $P[X \le K] = \frac{1}{2}$.

(8 marks)

(b) Define mean or average or expected value of a random variable. Explain how it is calculated for continuous and discrete random variables.

(4 marks)

[5 × 12 = 60 marks]